FORENSIC TOXICOLOGY

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2.0 Introduction: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

2.1 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.

2.2 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.

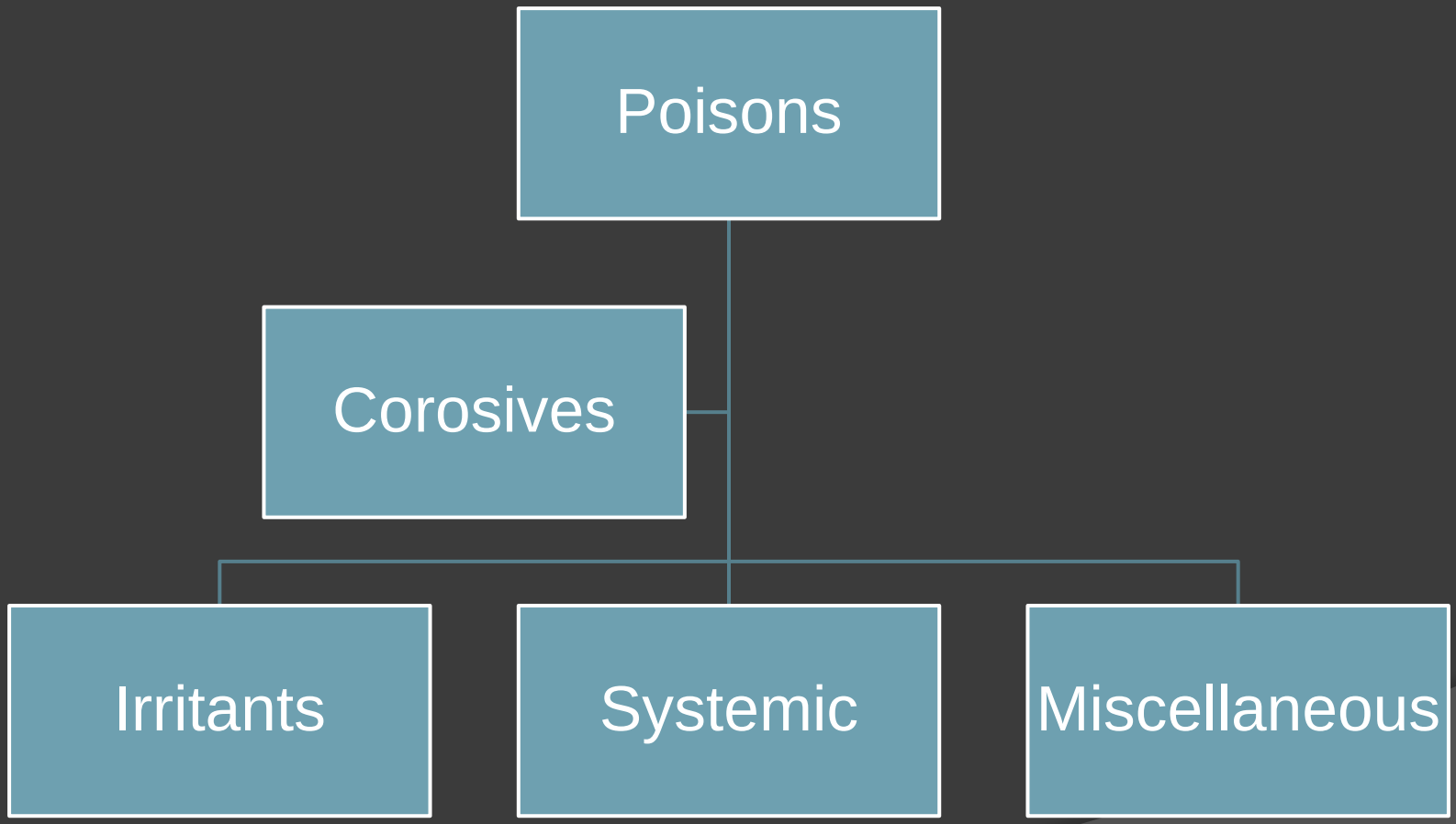
2.2.1 LAW OF POISONS:

- 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

Classifications



Corosives

- Strong acids
- Strong Alkalies
- Metallic salts

Strong acids

.Inorganic acids(or mineral acid) H2SO4,HCL,HN03

Organic acids – Phenol,Oxalic

HCN

Strong alkalies

Sodium hydroxide

Potassium hydroxide

Metallic salts

Zinc chloride, Ferric chloride,Copper sulphate,Silver nitrate

Potassium cyanide, Chromates & Dichromates

Irritants Poisons

Agricultural	Inorganic	Organic
Inorganic insecticide:- Nitrite Nitrate Phophorous	Metallic: Arsenic, Mercury,Lead,Silver, Zinc	Vegetable : Abrus Precatorius ,Castor,Capsicum, Calotropis.
Organic: Phosphate esters,Organo Chlorinated,Carbamat es,Rodenticide, Pyrethrins	Non metallic : Chlorine,Bromine, Iodine, Fluorine, Phosphorous,Carbon Tetra Chloride	Animal : Snake venom, Insect venom, Cantharides, Ptamine
Vegetable origin - Nicotine	Mechanical Poison – Powdered glass, Diamond dust, Hair	

Systemic Poisons:

Cerebral 1	Spinal 2	Cardio vascular 3	Asphyxial (Gaseous) 4	Mis cellanious 6
Central Nervous System Stimulant:- Amphetamine, Caffeine, cocaine, cyclic antidepressants	Strychnus Nux Vomica	Oleander, Aconite, Quinine, Tobacco, Cyanide	Carbon Monoxide, Carbon Dioxide, Hydrogen Sulphide	Food Poisoning, War Gases, Antihistamine ,Paracetamol Acetyl Salicylic Acid, Formaldehyde Sulpha Drugs Bio-Weapons Radio –Active Poisons.

2.3 CLASSIFICATION OF POISONS

2.3.1 CORROSIVES

Strong acids

Strong alkalies

Metallic salts

2.3.2 IRRITANTS

Agricultural

Inorganic

Organic

2.3.3 SYSTEMIC

Cerebral

Spinal

Peripheral

Cardiovascular

Asphyxiants

2.3.4 MISCELLANEOUS

Food poisoning, Botulism

Antihistamine

Acetaminophen

Paracetamol

Formaldehyde

Radioactive Poisons

Bio-weapons.

Classification Of Poison

2.3.1 CORROSIVE : ACIDS AND ALKALIS,METALLIC SALTS

a) Mineral acid (Sulphuric ,Nitric, Hydro Chloric)
b) Organic acid (oxalic, salicylic, carbolic, acetic acid)
c) Vegetable acid (Hydro Cyanic)
d) Alkalies:Sodium Hydroxide,Potassium Hydroxide etc.

a)Mineral Acid : 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 $H_2S_2O_7$ and is used in the manufacture of indigo dye

Symptoms :

Lips and tongue swollen,corroded,brown or black in colour.

P.M.Appearance:

Mouth,lips and surrounding skin shows brown or brownish –black corroded spots.Blackening of the stomach,perforation is more frequent.When there is no perforation ,stomach is collapsed and contracted,contents dark brown with mucus and altered blood .

Tests:Blue litmus red

Ph paper Test

Barium Chloride Test:Barium Chloride solution produces a white precipitate of Barium Sulphate.

Fatal dose: 5-10ml

Fatal period: 12-24hrs

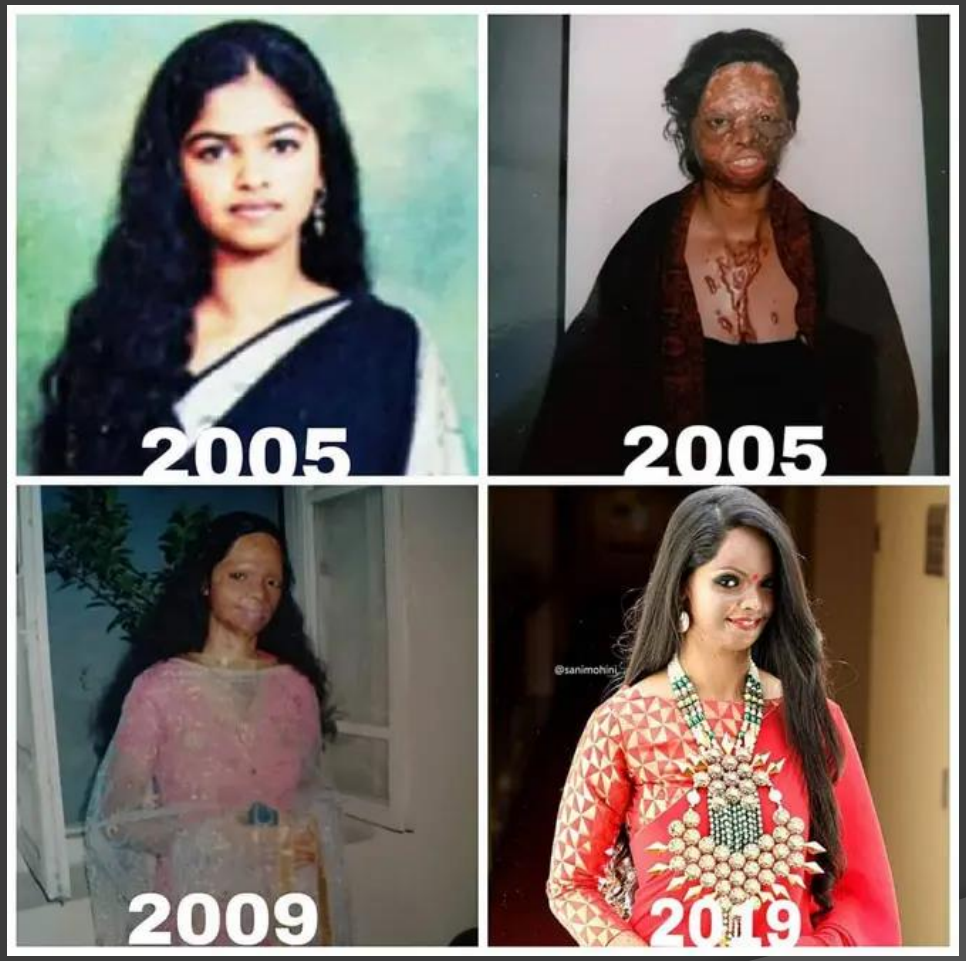
Vitriolage:Throwing of Sulphuric acid on another individual is known as Vitriolage.

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

Acid Bath Case:

- John George Haigh,a seral killer and known as Acid Bath Killer killed 3 people,William Swann,the wealthy owner of an amusement park and his parents and dissolved their bodies in Sulphuric acid stored in 40 gallon drum in London.This was followed by Archibald Henderson,a wealthy doctor who was shot in the head and body was dissolved in acid.The same fate happened to his wife.He sold their possessions and pocketed the money.
- Two more persons Olive Durant Deacon and Mrs.Durant Deacon were disposed of in a similar way.Detectives started investigating.
- The eminent Pathologist Professor.Keith Simpson discovered 3 human gallstones and part of Mrs.Durant-Deacon's dentures,all of which the acid had failed to dissolve.
- John George Haigh was found guilty , was sentenced to death and hanged on August 10,1949.

- Lakshmi Agarwal Case:
- Acid attack survivor at the age of 15 whose face and other body parts were disfigured by Sulphuric acid.Her Public Interest Litigation sought framing of a new law,amendment to the existing criminal laws like IPC,Indian Evidence Act and Cr.P.C. besides asking for compensation.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- Famous Acid Attack Cases:
- 1.Pragya Singh-Acid attack while travelling from Varanasi to New Delhi.
- 2.Daulat Bi Khan-Her elder sister and brother-in-law brutally attacked her with acid
- 3.Anmol Rodriguez-Was a 2 month old infant when her father doused them with a whole can of acid.Mother succumbed to the injuries whereas baby survived.
- 4.Chandrahass Mishra-Was attacked at the age of 27 for preventing a molestation attempt on a woman.
- 5.Firoz Khan-Was attacked by his neighbour with a bucket full of acid.
- Sonali Mukerjee-3 persons attacked her with acid when she didn’t respond to their ill motives.

- Section 326 A of IPC provides for minimum 10 years imprisonment for the offence of causing hurt by acid attack extendable to life and with fine.
- A minimum of Rs 3,00,000 was made available to each victim of the acid attack.
- The crime of throwing or helping someone throw acid is both cognizable and non-bailable.

- Acid attacks leave survivors with a raft of mental health issues such as anxiety,depression and post-traumatic stress disorder(PTSD).
- Katie Piper,a television host and former model of UK suffered a horrific acid attack in March 2008 resulting in extensive damage to her face,neck ,lost sight in one eye.She was attacked by a man named Stefan Sylvestre.

NitricAcid

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(shortness of breath) and asphyxia(lack of oxygen or excess of Carbon Dioxide results in unconsciousness). 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.

Organic Acid:
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):C6H4 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.
- Accidental poisoning occurs when children consume Phenol thinking its milk .

Color test for Phenol:

1) Ferric chloride test: Phenol gives a blue color.
2) Liebermann’s Test:Violet color positive for Phenol.

Case:

A child had consumed Phenol thinking it as milk.Stomach wash and Urine samples were received.Urine was deep green in colour.Detected Phenol in the stomach wash and urine samples received.

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 named 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.

Di-Cobalt 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.

F.D:50 to 60 mgm of pure acid.

200 to 300 mgm of Sodium or Potassium Cyanide.

F.P:2 to 10 minutes.Sometimes immediate.

Cases:

1)LTTE Case:Subha and Sivarasan :Involved in Thiru.Rajiv Gandhi assasination case when surrounded in Bangalore,they swallowed cyanide along with the glass ampoule which they had hung from the neck and died immediately.Cyanosis was observed.

2)A goldsmith committed suicide by consuming Cyanide as he had easy access to Cyanide.

3)In another case , a assistant professor commit ed suicide by consuming cyanide from the laboratory as she was accused of mismanagement of funds and died within a few minutes.

4)So far,it's heard that only a medical student survived from cyanide as his classmates gave him Amyl Nitrite inhalation followed by Sodium Thiosulphate which converted Cyanide to harmless Thiocyanate.

Cyanide Mallika:

5)Cyanide Mallika of Karnataka was in the habit of luring devotees visiting temple and killed 8 persons after giving Cyanide in the holy water.She kept changing her name and residence to avoid being caught by police.She was given death penalty commuted to life imprisonment. A movie has been made in her name.

d) 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.Oesophagus more vulnerable than Stomach.

Classification Of Poison

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

2) **Inorganic:**

- a) METALS: Arsenic,Lead,Mercury,Copper,Cadmium,Magnesium,Manganese,Zinc.
- b) NON METALICS: Chlorine, Bromine, Iodine, Phosphorous, Carbon Tetrachloride
- c) Mechanical poisons – Powdered glass, Diamond dust, Hair

3) Organic:

- a) Vegetable poison: Abrus Precatorius, Ergot, Madar, Castor oil,Marking nut, Capsicum
- b) Animal Poison: Snake venom, Scorpion venom, Cantharides.

Irritant Poisons:

1)Agricultural Poisons:

a) Insecticides of Vegetable Origin: They are Nicotine Pyrethrins and Rotenone.

b)Chemical Insecticides: Inorganic: They are Phosphorous and compounds of Antimony, Arsenic, Barium, Mercury, Thallium, Zinc and Fluorides.

c) Synthetic Organic Chemical Insecticides: They are divided into Phosphate Esters, Carbamates, Chlorinated Hydrocarbons.

a)Insecticide of Vegetable Origin: Nicotine:

Nicotiana Tobacum:Common names:Tobacco,Tambaku.

Dried leaves of Tobacco are used in the form of smoke or snuff or chewed with lime or with lime and pan.

Leaves contain the active principles which are toxic alkaloids Nicotine,Anabasine and Nor-nicotine.

Tests: Marquis Test:Rose red colour.

Meyers test:Yellowish white precipitate.

F.D:60 TO 100 mgms of Nicotine.

15 to 30 Gms of Crude Tobacco.

Nitrite &Nitrates:

- Inorganic Nitrite salts and Organic Nitrites and Nitrates are available in many houses as medicines,eg.Amyl Nitrite,Nitroglycerine,Sodium Nitrate etc.
- Sodium Nitrate causes relaxation of smooth muscle.
- Toxic doses converts Haemoglobin into Methaemoglobin.
- F.D:1 TO 2 Gms.
- F.P:Few hours to few days.
- Poisoning is usually accidental.

Test for Nitrite:

To the sample,add Alpha Naphthylamine and Sulphanilic Acid.Formation of Pink colour indicates the presence of Nitrite.

Test For Nitrate:

Brown Ring Test:

To the sample,add Ferrous Sulphate solution in dilute Sulphuric Acid. Add concentrated Sulphuric Acid along the sides.Formation of brown ring indicates the presence of Nitrate.

b)Chemical Insecticides:Inorganic: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 "Phosphorescense".
- Red Phosphorous: Reddish, amorphous, odourless substance. It is insoluble and harmless.

Uses:

- 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.

Trait	White P	Red P
1)Color	White or yellow	Reddish brown
2)Appearance	Transluscent	Amorphous
3) Smell	Garlicky	Odourless
4)Taste	Garlicky	Tasteless
5)Luminosity	Luminous in dark	Non-lumino

Trait	White P or yellow	Red P
6)Exposure to air	Ignites at 34 C So kept under water.	Non-inflammable
7)Use	Fertilisers,Rodenticide, Vermin killers,Fireworks	Matchbox sides Pyrotechnics
8)Toxicity	Highly Toxic	Non-Toxic

Synthetic Organic Chemical Insecticides: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 with1:5000 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.

Cases:

1)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 in our lab,Gammaxine was detected.

Gammaxine is an organo chlorinated compound.Used for treating lice, scabies and for killing ants.

2)In another case,a brides relative sprinkled gammaxene powder on laddus to prevent ants. Many people died and some vomited,some were saved in the hospital.

3)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.

Case:

An old person died after consuming tender coconut water.Detected Furadon in it.Excess Furadon had been sprayed to the coconut tree and this has been absorbed resulting in his death.

Rodenticide:
Aluminium Phosphide:

Is a solid fumigant,pesticide,insecticide and rodenticide.

In India,it is available as white tablet of Celphos.

On coming in contact with moisture,Aluminium Phosphide liberates Phosphine.

Aluminium Phosphide has garlicky odour.

Phosphine inhibits respiratory chain enzymes.

F.D:1 to 3 Gms.

F.P:1 hour to 4 days.

Zinc Phosphide:

This is a steel grey fine powder with a garlicky odour which is formed by direct combination of Zinc and Phosphorous on heating.It is not attacked by water but by cold dilute Hydrochloric Acid and Nitric Acid liberating Phosphine.

It reacts with the acid in the stomach and liberates Phosphine.

Commercial Zinc Phosphide is one of the well known rat poisons.

Causes death due to Asphyxia.

F.D:5 Gms.

F.P:1 Day.

Pyrethroids:

They have enhanced insecticidal activity and low mammalian toxicity.

Mosquito repellants contain Pyrethroids.

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.

Inorganic: Metallic Poisons:

Arsenic:Metal is not poisonous but when volatalised by heat,poisonous vapours of Arsenic Trioxide is formed.This is called as White Arsenic.

Compounds of Arsenic:

Realgar:Yellow

Orpiment:Red

Copper Arsenite:Scheele's Green

Copper Acetoarsenite:Paris Green or Emerald Green

Arsine Gas

Types of Arsenic Poisoning:

1.Fulminate:Massive doses of 3 to 5 gms causes death due to shock

2.Gastrioenteritis:Constriction of the throat,burning and colicky pain of the oesophagus,stomach and bowel occur.Stools are colourless,odourless and watery resembling rice water stools of cholera.Garlicky odour in 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.

Test:Reinsch Test:The specimen is heated in the presence of Hydro chloric acid in a copper wire wound to a glass rod.The Arsenic collects on the copper wire is washed in a gentle stream of water,dried with a filter paper and placed on the Reinsch tube and heated gently.Arsenic crystals revealed under microscope as dull black deposit.

Lead:

It’s a heavy steel grey metal. The metal and all it’s 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.

Test:When Hydrogen Sulphide is passed through acidic sample solution,a black precipitate is obtained.

2)Ammonia Test:When Ammonium Hydroxide is added,a pale blue ppt is obtained which dissolves in excess to form a inky blue solution.

3)Potassium FerrocyanideTest:In neutral or acid medium,Potassium Ferrocyanide produces a reddish brown precipitate which dissolves in Ammonia solution to produce a dark blue solution.

Mercury:

Quick Silver is a liquid metal, has a bright silvery appearance, volatile at room temperature. Occurs as Mercuric compound -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 .

Mercury is a nephrotoxin produces tubular necrosis.

FD: 1 to 2 gm of Mercury chloride.

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 after cutting off light.Shiny white metallic globules of Mercury seen.

Non - Metallic

Chlorine,Bromine:

Chlorine: It is a greenish yellow gas having a unpleasant odour.It is an active oxidizing agent and causes extensive destruction of organic tissue.Causes laryngeal and pulmonary oedema,respiratory failure.Death caused by cardiac failure.

Bromine: Is a dark reddish brown liquid volatalising at ordinary temperature, producing irritating fumes of an unpleasant odour.In the free state ,it is found only in laboratories and chemical works.It is a corrosive poison and when fumes are inhaled ,produces oedema of the glottis and larynx and death from suffocation.

Iodine:

This is a solid, having bluish-black, soft, scaly crystals with metallic lustre and an unpleasant taste. At all temperatures iodine gives off a violet coloured vapour, possessing a characteristic odour.It is only slightly soluble in water but freely soluble in alcohol, ether, chloroform,glycerine and Carbon disulphide.

Iodine when swallowed is a corrosive poison while its vapours are strongly irritant to the respiratory passages.

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 "Phosphorescense".
- Red Phosphorous: Reddish, amorphous, odourless substance. It is insoluble and harmless.

Phosphorous:

- 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.

Irritant Mechanical Poisons: Powdered Glass:

This includes Powdered glass,pins,needles,inhalation of glass fibres,chopped animal hairs,diamond powder etc.

Glass:

Taken internally,powdered glass produces sharp burning pain in the throat,stomach and later in the intestines followed by nausea,vomiting,vomited matter with streaks of blood.Motion mixed with blood.

Death may occur from shock especially if stomach or intestine has been perforated.

Medico –Legal Importance:

Used rarely for suicide or homicide purposes.

Used as cattle poison.

Identification: By Refractive Index,Spectrographic Analysis.

Treatment:Give bulky food and later emetics and purgatives.

Give ice and morphine to relieve thirst and pain.

Hair:

Vegetable Hair:

Fine,short hairs derived from the leaves and stalks of certain plants are called “Stinging hairs” and act as mechanical irritants when they come into direct contact with the skin.

These hairs taper towards their apices and terminate in small bulbs which contain an irritant fluid consisting of histamine and acetyl choline.Example is Mucuna Pruriens,the cow-itch or cowhage or Russian Fleas, produce local redness with a strong burning sensation followed by intolerable itching,inflammation and even blisters when applied to the skin.

Treatment: Involves washing the part with warm water containing alkali such as Sodium Carbonate.

Ephedrine hydrochloride may be given hypodermically if the skin rash is of an urticarial nature.

Hair:

Chopped Animal Hairs:

These are supposed to be poisonous and are being given to cattle with the idea of destroying them and can be detected in the stomach and intestines of animals.

Human Hair:

Finely chopped human hair is recognized as a slow poison and given with food.

Chopped human hair mixed with lime,earth or powdered bone is used as a cattle poison particularly in some States of Bihar and Bengal.

Case:

A wife gave her husband tuft of chopped hair mixed with rice and vegetables to seek revenge.He suffered from severe stomach ache.X-ray revealed hair in the stomach and intestines and was treated accordingly.

Diamond Powder:

When swallowed,diamond or diamond powder may produce injurious effects owing to the mechanical action of its sharp prominent angles and edges.

However owing to a false popular belief that it is highly poisonous,diamond powder is sometimes taken suicidally or administered homicidally.

Diamond pieces are sharp like glass pieces and cuts inner walls of small intestine causing excessive internal bleeding and death is due to loss of blood.But diamonds swallowed as a whole will be excreted and do not cause any harm.

Case:

In a Madras case,a man consumed powdered diamond with suicidal intention.Immediately,he was rushed to the hospital where stomach wash was given and later administered butter and boiled rice.He recovered and stomach wash revealed minute transparent diamond particles under microscope.

World's largest diamond,Kohinoor weighing 105 carrot and now worth $591 million is with the royal family of England.

2.3.2 Irritant Poison - Organic - Vegetable - 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.

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alamy
alamy

Abrus Precatorious:

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:

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.

F.D:5 to 10 gms

F.P:12 to 24 hours.

MADAR - CALOTROPIS

There are two varieties

Calotropis gigantea – Purple flowers

Calotropis procera – White flowers

The active principles are

i) Uscharin

ii) Calotoxin, iii)Calactin iv)Calotropin.

Applied to the skin,it causes redness and vessication.Taken by mouth produces burning pain in the throat,stomach,vomiting,dilated pupils,tetanic convulsions ,collapse and death.

F.D:Uncertain

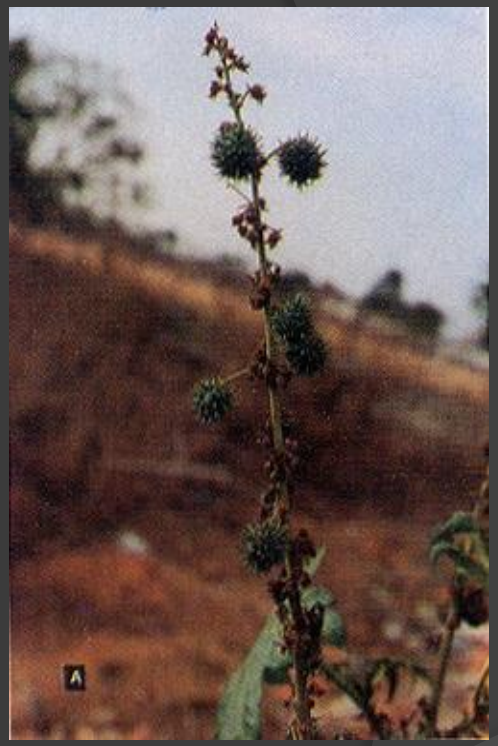
F.P:6 to 12 hours.

Sui Poison:

Sui Poison:

- Seeds are crushed and added with paste of Arsenic,Lead,Calotropis and made into injecting needles and used to kill the enemy by blowing using a bamboo stick.
- Calotropis used as a cattle poison.

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:5 to 10 seeds.
F.P:2 to 5 days.
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.
Case:
Some thieves entered a posh house in a remote locality,robbed jewels and poured chilli powder so that sniffer dogs cannot identify them but still they were fixed due to adherence of chilli powder on their dresses and this was compared instrumentally with the chilli powder from the scene of crime .

Irritant Animal Poison:
Snake: Snake venom is saliva of the snake.

1) Elapids-Neurotoxic(Poisonous to Nervous system) – Fangs are 4-6mm[eg.King Cobra, Kraits, Mambas]

2) Vipers –Vasculotoxic(destructive to blood vessels or vascular system) – Fangs are 12-15mm

3) Sea Snakes- Myotoxic(Toxic effect on muscle)- 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.

Some high society men use it for aphrodisic purposes

Snake Venom:

Fatal Dose:

Cobra:12 mg

Russell's Viper:15 mg

Krait:6 mg of dried venom.

Fatal Period:

Cobra :Half to six hours.

Viper:One to four days.

First aid to be given.

Case

:Kerala Case:

A victim Uthra was killed by husband Suraj Kumar using Cobra.He was sentenced to 17 years imprisonment,a double life imprisonment and a monetary penalty of 5 lakh rupees by Honorable Judge M.Manoj of Kollam Sessions Court.

Treatment:Polyvalent anti-snake venom(PAV) should be given.It is useful when given within 4 hours and is of doubtful value after 24 hours.

Each vial of PAV will neutralize about 6 to 8 mg of venom.

Poisoning;Isalways accidental.Used for homicide also.Cattles are sometimes poisoned by Snake venom.

- **Scorpions**:They are 8 legged anthropods and have a hollow sting in the last joint of their tail. The venom is a clear, colourless toxalbumin and can be classified as haemolytic or neurotoxic.There are more than 1250 species of Scorpions.
- Colour:Varies from light yellow to black.
- Specific antivenin is available for most species.

Bees and Wasps: The venom is a complex mixture of simple amines to complicated proteins , enzymes and histamines.

Painful and sometimes fatal reaction occurs in humans.

Anaphylactic reaction may occur immediately or within 20 minutes. There is respiratory distress,faintness and unconsciousness. A rash may develop.

Death may occur in 2 to 15 minutes.

Cantharides:

The Spanish Fly(Blister Beetle) has Cantharidin as the active principle.The powder of the dried body is greyish brown and contains shiny green particles.It is used externally as an irritant. Applied to the skin,produces redness and burning pain. Taken internally,there is burning sensation in the mouth and throat followed by pain in the stomach,nausea and vomiting of bloody mucus.

F.D: 15 to 50 mgs of Cantharidin or 2 to 3 gms of powdered Cantharides.

F.P:24 to 36 hrs.

Poisoning:

1) Accidental

2) Homicide rare

3) Used for criminal abortion

4) Used as an aphrodisiac.

CNS Stimulant: Amphetamines:

Amphetamines increase the synaptic concentration of neurotransmitters Dopamine and Norepinephrine.

They are powerful stimulants of CNS and CVS.

It may be taken orally,i.v,smoked or sniffed.

Symptoms:Acute poisoning :Symptoms are similar to Cocaine Poisoning.It may be mild,moderate to severe.

Amphetamines:

Chronic Poisoning:

Delusions,hallucinations,stereotyped compulsive behavior,Cardiomyopathy,Intracranial haemorrhage.

F.D:1 to 2 Gms.

Amphetamines are used for weight loss and are often used by actors/actress for this purpose.

Case:1)A 40 year female who used Heroin with Amphetamine suffered from Renal infarction .

2)Recently Methamphetamine worth Rs 2000 crore has been seized in New Delhi.

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 a antidote-given by inhalatio

Airway and Circulatory stabilization

Thiamine 100 mg i.v.

Naloxone Hydrochloride 2 mg i.v.

Symptomatic Treatment.

Case:1:Body packing of 2 kg cocaine was done in stomach and digestive tract and this was revealed in x-ray

2.A Nigerian in the Madras airport was looking nervous before check up and sniffer dog was licking his shoes and barking all the time.He was asked to remove the shoes and on examination revealed cocaine packets in the secret compartment of his shoes.

Cocaine Powder:

CEREBRAL POISON: INEBRIANT POISON(Causing intoxication especially drunkenness):

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.

Blood Alcohol Levels and Clinical Manifestations:

100 to 150 mg	Under the influence
150 to 200 mg	Drunk
200 to 300 mg	Very drunk
300 to 350 mg	Stupor to Coma
Over 350 mg	Comatose to death

Alcohol Elimination

2 mechanisms for elimination:

1)Oxidation 2)Excretion

Oxidation :Takes place in the liver

Ethanol oxidized to Acetaldehyde
Acetaldehyde further oxidised to

Acetic acid and then to Carbon-dioxide and Water.

2)Excretion:

Breath,Perspiration,Urine.

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(fear of light).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:Violet color formation .

Case:

1.Methanol laced drinks kill 54 people in Peru.

2.As many as 22 people had died after consuming spurious liquor in Chengalpattu and Villupuram in May 2023.

3.Methanol kills at least 59 people in Uttar Pradesh and 31 in Uttarakhand.

CNS Depressant:Cerebral Poison:Michael Jackson

Anaesthetic Death:Death of Michel Jackson in 2009- over dosage of anaesthetic Propofol .Propofol is a short acting medication that results in a decreased level of consciousness and a lack of memory of events.Used as a general anesthesia.

Conrad Murray –His Physician was accused of involuntary manslaughter. Punishment was 4 year in jail- 2 years let out early for good behaviour and due to prison over crowding.

CNS Depressant:
Opium:

1)Is a somniferous poison-induces sleep.

Alkaloids present are:

1) Morphine

2) Codeine

3) Thebaine

4)Papaverine

5)Narcotine.

2)Naturally occurring Opium and the derivatives are called Opiates

Example are

Diacetyl Morphine(Heroin)

Buprenorphine

Pentazocine.

Tests:

Marquis Test: Violet color

FroehdeTest: Play of colors:From violet to green and finally to pink or rose red.

Test For Meconic Acid:

With neutral Ferric Chloride,blood red color obtained.This is not destroyed by boiling or by addition of Hydrochloric Acid or Mercuric Chloride.

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(drowsiness or unconsciousness)

Cerebral Poison:Depressants

That slow brain activity, which makes them useful for treating anxiety and sleep problems.

1)Barbiturates:

Phenobarbitone

Amylobarbitone

Secobarbitone

Butabarbitone

Pentobarbitone

Actress Marilyn Monroe:Died of Barbiturate poisoning(Pentobarbitol)

2)Benzodiazepine :

Diazepam

Nitrazepam,

Lorazepam ,

Oxazepam

Alprazolam

Deliriant Poison: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

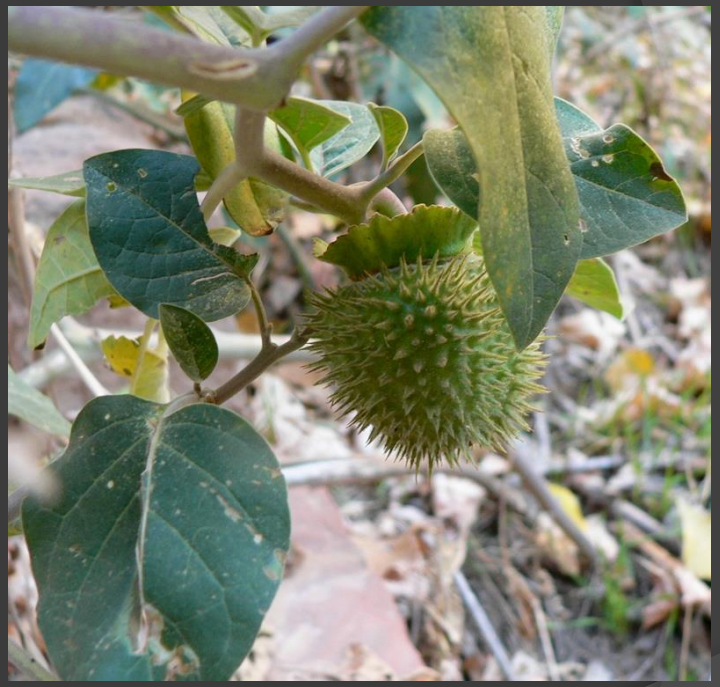
Hyoscyamine

Traces of Atropine.

Datura is a stupefying poison.

Delirium is a serious change in mental abilities.

Stupefying :making one unable to think or feel properly



Deliriant Poison: Datura:

8 D Rule:
Dryness of the mouth
Dryness of the throat
Dilated pupil
Dryness of the skin
Dyspnea(Difficulty in breathing)
Dysphagia(Difficulty in swallowing)
Delirium
Death occurs from paralysis of heart or respiration.

Deliriant Poison:
Atropa Belladona:(Deadly Night Shade)

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

They contain 3 alkaloids:
Atropine
Hyoscyamine
Belladonine.
Atropine:C17H23O3N 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.

F.D:Variable
F.P: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 .

Deliriant Poison:

Cannabis Sativa:

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.

Ganja Plant:

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.

Hashish Oil:

Spinal Poison:
Strychnos Nux Vomica:

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

- Strychnine:$C_{21}H_{22}N_2O_2$: 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.It’s 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.

Case:

A lady complained that her child was suffering from convulsions.After enquiry,she revealed the fact that she was administering a ayurvedic preparation to her child.On chemical analysis,Strychnine was detected and she was advised to stop the medication.Antidote was given and the child recovered fast.

Cardio Vascular Poison:
Oleander: Nerium Odorum:White Oleander:

All parts of the plant except root are poisonous in nature. Cardiac Glycoside are Oleandroside (Oleandrin) and Nerioside(Nerin)

Symptons: Abdominal pain,vomiting, dilated pupil,lock-jaw,drowsiness,coma,respiratory paralysis and death occurs.

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Treatment:
Stomach wash .symptomatic treatment
Used mainly as suicidal poison.
Homicide rare. Cattle poison.

Cerebra Thevetia:Yellow Oleander:

.All parts of the plants are poisonous in nature.
ActivePrinciples: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 weak and irregular.Heart block,collapse and death from peripheral respiratory failure.
Treatment:Stomach wash
ECG Monitoring
I.V Sodium molar lactate solution and 5% Dextrose to combat shock.
Atropine 1 mg,
Adrenaline 0.2ml and IV

Case: 1.In a unknown poisoning case,stomach contained black seeds along with food material.On chemical analysis,Oleander was detected.

2.In another case.a lady died during abortion and the stick was also sent for chemical examination..On analysis,Oleander was detected in the viscera and on the washings of the stick.

Circumstances of Poison:Commonly used as a suicidal poison ,cattle poison and as abortifacient,and

as cattle poison.

Nicotiana Tobacum (Tobacco):

All parts of the plants are poisonous except the ripe seeds.The leaves contain toxic alkaloids
Nicotine ,Nor nicotine and Anabasine.
Dried tobacco leaves are chewed,smoked and used for snuff.
Absorbed from skin,lungs and from all mucous membranes.
Detoxicated in the liver.
Excreted by kidneys.
F.D:60 to 100 mgs.
F.P:5 to 15 minutes.

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 it's 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.

Fatal Dose:200 to 400 gm of leaves.

F.P:One to three days.

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.

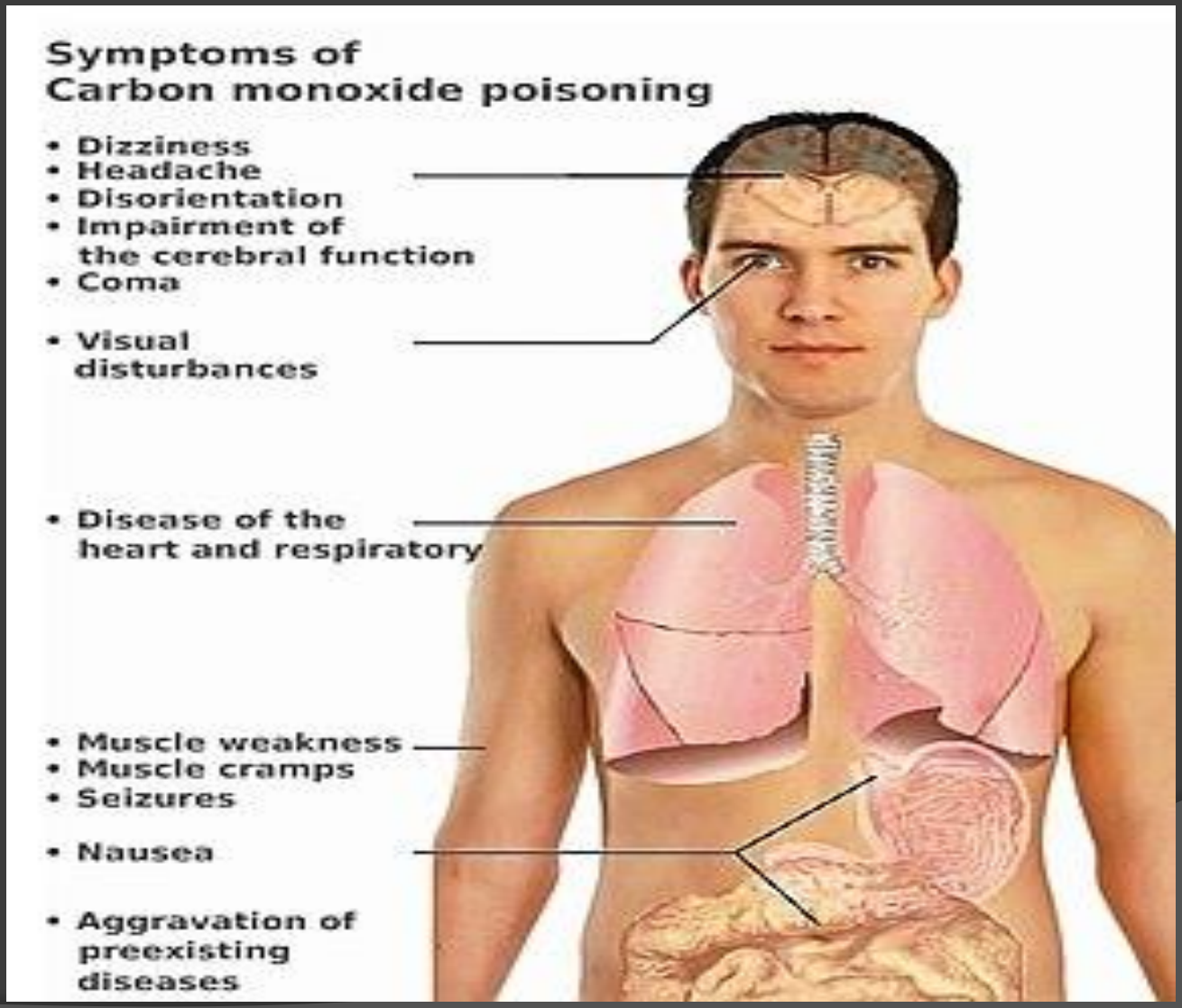
Leaves as paste and decoction :used for criminal abortion and as cattle poison.

Bark as fish poison.

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 Carboxy haemoglobin. 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.

CO poisoning:



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.

Treatment:Move the person away from the area.

Expose the person to fresh air.

Begin CPR if necessary.

Hyperbaric Oxygen Therapy

Vehicle exhaust fumes and bushfires are the highest emitters of Carbon Monoxide.Charcoal heaters such as barbeques,gas stoves,gas water heaters,fireplaces and gas dryers are other sources of Carbon Monoxide.

Case:

1.A couple burnt coal to keep the room warm but died due to inhalation of Carbon Monoxide fumes.

2.Four persons were found dead in a car due to Carbon Monoxide poisoning.

Carbon Dioxide:

Relatively inert,has no poisonous or cumulative effect.It can cause headache,rapid breathing or shortness of breath,increased blood pressure.

Minimum fatal concentration is said to be 25 to 30%.

Treatment:Remove the patient to fresh air.

Give first aid.

Hyperbaric Oxygen Therapy.

Ammonia:

Inhalation produces choking,coughing,pulmonary oedema,breathing difficulty.

Maximum permissible concentration is 100 parts per million.

Treatment:There is no antidote for Ammonia poisoning.

Treatment consists of supportive measures.

Treatment of skin and eyes with copious irrigation

Administer humidified Oxygen and broncho dilators and airway management

Hydrogen Sulphide:

It is a colourless,heavy,flammable gas with rotten egg smell.Higher concentrations like over 50 ppm results in sense of smell being lost.

Hydrogen Sulphide in combination with Methane,Nitrogen,Hydrocarbon,Ammonia and Carbon Dioxide in sewers is known as ‘’SEWER GAS’’.

Normal tolerable level is 20 ppm and levels more than 100 ppm is dangerous to life.

Poisoning is generally accidental especially in sewer workers.

It forms Sulph Methaemoglobin.It interferes with Cellular Respiration by inhibiting the action of Cytochrome Oxidase Cyanide.

Asphyxiant Poison:Phosphine:

Is a colourless,flammable,highly toxic gas with an odor of decaying fish.Affects central nervous system.It's a mitochondrial poison.Inhibits the body's ability to produce proteins.Causes respiratory irritation.

A concentration of 2000 ppm is lethal.

Treatment:No antidote for Phosphine poisoning.

Treatment consists of supportive measures.

Peripheral (Neural) Poison:Conium Maculatum (Common or Spotted Hemlock):

This plant belongs to N.O.Umbelliferae,has a peculiar musty odour.

Conium Conine Maculatum: (Hemlock):Poisonous properties are due to alkaloid Coniine and Methyl Coniine.It also contains a crystalline alkaloid Conhydrine and Conic Acid.All parts of the plants are poisonous especially the seeds and roots and when ingested.

Treatment:No antidote.

Should be treated symptomatically.

F.D:Uncertain.2 grains will probably prove fatal.

F.P:Death occurs in a few minutes.Sometimes in 1 to 3 hours.

In 2010,German historian-Christoph Schaefer and Toxicologist-Dietrich Mebs announced after research that Cleopatra actually used a mixture of Hemlock, Wolfsbane, opium along with venomous Egyptian Cobra to end her life.

Peripheral Poison:

Curare:

A highly toxic poison containing alkaloids Curine and Tubocurarine. Used as a arrow poison and as a paralysing agent.

Treatment: The antidote for Curare poisoning is an Acetyl Choline Inhibitor such as Physostigmine and Neostigmine.

Curare is effective in the treatment of Tetanus and Strychnine poisoning.

Food Poisoning

1) Infection type: It is gastroenteritis due to mainly
Salmonella group(Bacteria).

2) Toxin type: Presence of enterotoxin (affecting intestine)
formed by Staphylococcus- source tinned foods.

3) Botulism:A rare poisoning caused by toxins produced by Clostridium Botulinum bacteria.It attacks the body nerves and causes difficulty in breathing. Clostridium botulinum mulitiplies in food and produce exotoxin(secreted by the bacteria).

Botulism can be fatal and requires emergency medical care.It can occur in infants and spread through food or open wound.

Treatment:

Breathing assistance and antitoxin injection should be given

Supportive care and transfusions will be helpful.

In the last 13 years ,at least 9646 food poisoning cases have been reported in India.

According to Journal of Medical Science,about 2 million deaths happen every year in India due to contaminated food and water.

Food Poisoning:

Causes: Due to 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 belladona, solanine.

iii. Poisons of animal origin:1) Poisonous fish eg. Toad fish, cat fish, lion fish, dragon fish, balloon fish, puffer fish, sun fish, shell fish, stone fish, scorpian fish , box jelly fish. 2)Mussel

iv. Chemical: Intentionally added such as flavouring agents in processed food, colouring agent, preservatives to accidentally added insecticides.

3. Products of food processing eg. Smoking of fleshy foods.

4. Radionuclide

Cases:

1.Worst Salmonella outbreak of 2008 from Peanut Corporation of America resulted in the death of 9 people and affected 714 people across 46 US States.

2.A nurse in Kerala died after eating rice dish and barbecue chicken,21 others who ate in the same eatery also fell ill .Police invoked charges of culpable homicide against the owner and the cook.

Botulism:

A rare poisoning caused by Clostridium Botulinum Bacteria.It does not grow in body but produces neurotoxin. It is present in soil, dust, intestinal tract of animals and enters food especially through fruits and vegetables .It can occur through wound contamination also.Used as Biological weapon.

Cases:

1.Dangerous weight loss trend triggers Iatrogenic Botulism outbreak in Europe.About 53 cases were reported in Turkey whom required hospitalisation.

2.Italy notified the highest number of Botulism cases followed by France.

3.Botulinum type A is used as Botox to overcome wrinkles and aging.Botox contains 100 units of Clostridium Botulinum(0.73 ng)

Virus:

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

Noro virus referred as Winter vomiting disease is the most common cause of gastroenteritis charecterised by non bloody diarrhea,vomiting and stomach pain.

RotaVirus:is a genus of double stranded RNA Viruses in the family of Reoviridae.Causes diarrhoea among infants and young children.

Ptomaines: Theses 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 Neuro-lathyrism.

2.3.4 Miscellaneous Poisons: Antihistamines:

Histamine is a nitrogenous compound involved in the local immune responses as well as regulating physiological functions in the gut and acting as a neurotransmitter for the brain,spinal cord and uterus.

As a part of the response to foreign pathogens,histamine is produced.

Physiological effects of histamine:

Allergic and inflammatory reactions.

Commonly administered antihistamines are:

Diphenhydramine(Benadryl),Promethazine hydrochloride.

Depresses CNS System followed by drowsiness.

F.D:1 Gm.

Poisoning:Usually accidental.

Sometimes suicidal.

Paracetamol (Acetaminophen):

Absorbed rapidly from gastrointestinal track and metabolized quickly in the liver.It is a potent hepatic toxin.Large doses act on brain stem and cause rapid death.Toxic doses cause depletion of Glutathione which result in hepatic necrosis.

F.D:20 to 25 gms.

F.P:3 to 4 days.

Treatment:

1) Gastric lavage

2) Activated charcoal

3) N-Acetyl Cysteine (NAC) is a specific antidote

4) Hemodialysis

5) Symptomatic Treatment.

Acetyl Salicylic Acid (Aspirin)

It is a white odorless ,crystalline powder having a slight acid taste.It is used as a antipyretic and analgesic.

Symptons:

Burning pain in the throat and mouth,nausea,vomiting,vertigo,ringing in the ear,impaired vision,metabolic acidosis with respiratory alkalosis and ketosis, suggest Salicylate poisoning.

Death occurs from acidosis,peripheral failure or respiratory failure.Aspirin can cause sudden cardiac arrest.

F.D:Aspirin 15 to 20 gms.

F.P:Few minutes to several hours.

Treatment:

1)Emetics

2)Stomach wash with 5% Sodium Bicarbonate.

3)Forced alkaline diuresis.

4)Peritoneal and hemodialysis.

Poisoning is always suicidal .

Sulpha Drugs:

Used against a broad range of bacterial infections.Large doses produce Idiosyncratic Reaction.Sometimes even death. Eg are Septrin,Bactrim etc.

DMAB Test:

Sample+0.5 to 2.0 gms of Para Dimethyl Amino Benzaldehyde in 50 ml of 95% ethanol and 50 ml of Concentrated Hydrochloric Acid gives yellow to orange colouration.

Formaldehyde:

It is a colorless gas having a strong pungent,irritating odour.40% solution in water is known as Formalin.

Commercial Formalin contains 37%Formaldehyde and 10 to 15% Methanol.

It is readily absorbed in upper respiratory tract.

Symptons:

Inhalation causes burning of eyes,lachrymation,constriction in the chest.It can cause contact dermatitis.

It is used as disinfectant,for preservation of specimens,in plastic and in dyeing industry,as a reducing agent.

F.D:30 to 60 ml.

F.P:One to two days.

Treatment:1)Wash the stomach with 0.1% solution of Ammonia as it reacts with Formaldehyde to produce harmless Methenamine.

2)Symptomatic treatment.

Radioactive Poisoning:

Causes Acute Radiation Syndrome(ARS).It is an acute illness caused by irradiation of the entire body by a high dose of penetrating radiation in a very short period of time.There are 3 types of radiation poisoning.They are Cardio vascular/CNS Sickness,Gastro intestinal sickness and hematopoietic sickness.

Case Study:

Alexander Litvinenko,former officer of Russian FSB fled to UK and sought asylum after going against Russian President Vladimir Putin.He was poisoned and murdered by two of his former colleagues with Polonium 210,a very high radioactive substance.Died on November 23,2006 ,despite treatment.

This case obviously shows that the trend of poisoning is undergoing drastic change in the recent years.

Bio-Weapons:

Biological Warfare:Also known as Germ Warfare

is the use of biological toxins or infectious agents such as bacteria,viruses,insects and fungi with the intent to kill ,harm or incapacitate humans,animals or plants as an act of war.

Biological Weapons:Often referred to as Bio-Weapons,Bio-Agents,Biological Threat Agents are living organisms or replicating entities(viruses that are not universally considered alive).

Entomological(Insect)Warfare :Is a subtype of biological warfare.

Common Biological Weapons:

Smallpox,Anthrax,Plague,Botulism,Tularemia and Hemorrhagic fever viruses are six agents identified by the Center for Disease Control and Prevention(CDC) as the most likely to be used Biological Weapons.

Botulism weapon can be extremely lethal causing paralysis,death and long term hospital care for those who survive.

One gram of Botulism toxin is enough to kill a million people when inhaled.

Ebola Virus:

Causes severe bleeding, organ failure and lead to death.It is used as a bioterrorist weapon.

SARS:

Severe Acute Respiratory Syndrome is a severe respiratory illness that is caused by Corona Virus.

COVID-19:

Corona Virus Disease 2019 is a disease caused by a virus named SARS-CoV-2.

Engineered Viruses are the new Biological weapons.

Cases pertaining to Biological Warfare:

1650:Polish fire saliva from rabid dogs towards their enemies.

1763:British distribute blankets from smallpox patients to native Americans.

1971:Smallpox killed three of the ten people infected in Kazhak city.

1976:Ebola Virus:Also called as Ebola Hemorrhagic Fever.The virus causes severe bleeding,organ failure and can lead to death.Caused 11310 deaths and leaving 28616 infected

1979:Anthrax is a rare but serious bacterial illness.Anthrax break out in Soviet Russia due to accidental leakage from a bioweapons factory causing infections and lots of death.

SARS:Is Severe Acute Respiratory Syndrome.First recognized in China in 2003 and spread to various regions of the world.SARS is charecterised by severe pneumonia like symptoms which can be fatal.Transmitted from person to person through respiratory droplets.

COVID 19:Corona Virus Disease is an infectious disease caused by the SARS-CoV-2 Virus.Causes severe respiratory syndrome.Worldwide 6,952,522 deaths have been reported. 768,560,727 cases have been confirmed.It is a suspected Chinese biological weapon.

Corona Viruses:

Are a family of viruses that can cause respiratory illness in humans.They are called ‘Corona” because of crown like spikes on the surface of virus.

SARS and MERS and the common cold are examples of coronaviruses that cause illness in humans.

The new strain of coronavirus –SARS-CoV-2 was first reported in Wuhan,China in December 2019.It has since spread to every country around the world.

Diagnostic Testing:

- RT-PCR Test:Also called a molecular test,COVID-19 test detects genetic material of the virus using a lab technique called Reverse Transcription Polymerase Chain Reaction(RT-PCR).Nasal swab is subjected to this test.

2.3.5 Where are the best places to collect samples?

Where the chemical enters

Where the chemical concentrates

Along the route of elimination

2.3.6 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…natures timeline
- Insects – toxins can accumulate (bioaccumulation) in the bodies of insects that feed off of decomposed bodies.

2.3.7 Poisons which bring Constriction of pupil

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

2.3.8 Poisons which bring Dilatation of pupil

Cyanide

Corrosives except carbolic acid

Alcohol (initial stages)

Digitalis

Datura

Cannabis

Atropa Belladona

Strychnine.

2.3.9 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.

2.4.0 Poisons used as arrow poison

Abrus precatorius

Aconite

Croton

Curare

Calotropis

Strychnine

Snake venom

Scorpion venom

2.4.1 Poisons causing convulsion

Cyanide

Strychnine

Lead

Arsenic

Aconite

Cobra snake

Opium

Organo-Phosphorous

2.4.2 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
Tannin	1 part	Precipitates metals,alkaloids and glucosides

2.4.3 Techniques

1.Specimen extracted

2.Identification of substance

3.Screening procedures

4.Thin layer chromatography

Confirmation:

Gas chromatography

UV Spectrophotometry

IR Spectroscopy

Mass spectroscopy

GC-MS

Ion Detector

Atomic Absorption Spectro Photometry(AASP)

Fourier Transform Infrared Spectroscopy(FTIR)

Cases Received From:

- Judiciary,Police Surgeons/Medical Officers,Tahsildar,RDO,Private / Payment Cases.
- Cases pertain to Homicide,Suicide and Miscellaneous cases.This includes murder,strangulation,smothering,throttling,asphyxia death,hanging,drowning,rape cases,grievious hurt,unnatural offenses,vehicle accident cases.

Check The Following When Samples Are Received:

- Magistrate Requisition/Police Surgeon,Crime no,Name of PS,Accused name,No of case articles,Identity of the Messenger,Name of the Deceased,Post Mortem No,Date,Signature of the Magistrate/Police Surgeon and their seal.
- If any discrepancy arises,the samples may be returned to the concerned with covering letter.

2.4.4 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.