Flouride

- Used as rodenticide.
- Treatment of choice is calcium.

Aluminium Phosphide (Celphos)

- 3 gms of ALP liberates 1 gm of phosphene, a systemic poison.
- It inhibite cytochrome oxidase.
- Garlic like odour.
- Liver shows centrizonal haemorrhagic* necrosis
- Treatment of choice is MgSO₄ however no specific antidote is given.
- Activate charcoal and paraffin for adsorption and excretion of PH₃ respectively.

METALLIC POISONS

Arsenic

- Metallic arsenic is not poisonous, as it is not absorbed from the alimentary canal.
- Poisonous compounds:
  1. Arsenious oxide or Arsenic trioxide
     (Sankhya or Somalkar): it is known as white arsenic. It has been found to be useful in treatment of Acute Promyelocytic Leukemia (APL).
  2. Copper acetoarsenate (paris green): It combines with sulphydryl enzymes and interferes with cell metabolism.
  3. Copper Arsenate (Scheele’s green).

- Signs and Symptoms:
  1. The 'Fulminant type': Large doses of arsenic can cause death in one to 3 hrs from shock.
  2. The Gastro enteric type: This is acute poisoning, resembling bacterial food poisoning or cholera.
    - This is the most common form.
    - The stools are expelled frequently and involuntarily, are dark coloured, stinking and bloody, but later becomes colorless.
odourless and water resembling **rice water stools of cholera.**
- Sequence of symptoms:
  - Throat pain
  - Vomitting (Bile, Blood and Mucous)
  - Purging (Tenesmus present)
  - Arsenic poisoning resembles
    - Pre malignant condition
    - Cholera
    - Fading measles
    - Addison’s disease.
  - Fatal dose: 0.1 to 0.2 gm or 100 to 200 mg
  - Fatal period: 1-2 days
  - Treatment
  1. Freshly prepared precipitated hydrated **ferric oxide** (arsenic antidote)* is given. Dialysed Iron is substitute.
  2. In arsenic poisoning **BAL** is an antidote. (**BAL** is contraindicated in **cadmium** and **iron poisoning**).
  3. Calcium disodium versenate
  4. Alkali is contra indicated.

**Postmortem appearance**
- **Red Velvety** appearance of the stomach mucosa.
- Subendocardial haemorrhage of heart.*
- Chronic poisoning:
  1. CNS—Polyneuritic, optic neuritis
  2. SKIN—finitely mottled brown change mostly on the temples, eyelids and neck (**RAIN DROP PIGMENTATION**) ×
- There may be a rash resembling **fading measles rash** *
- Hyperkeratosis and Hyperpigmentation of the palms and soles with irregular thickening of the nails is seen.
Nails show ALDRICH MEE’s line (Leukoparonychia). \{Conifer* Beau’s Lines \rightarrow Chronic Systemic Disease, also \}
Muehrcke’s Line \rightarrow hypo proteinemia \}
Nails show ALDRICH MEE’s line (Leukoparonychia).

Medicolegal Importance
- Arsenic is the most popular homicidal poison.
- Napoleon was killed using Arsenic poison (c.f. Socrates was killed using Hemlock poisoning).
- It delays putrefaction.
- It can be detected in completely decomposed body.
- It can be found in bones, hair and nails for a long time.
- It can be detected in charred bone and ashes.
- It is sometimes used in abortion sticks.
- Arsenic causes Black foot disease.*
- Marsh test and Reinsch test are important Chemical tests*
- Early stages: greatest quantity in liver. Later keratin tissues: BONE, HAIR & NAILS.
  Test for Arsenic
  I Reinsch Test
  II Marsh Test (mARSenich)
  III Gutzeit Test.

MERCURY
- Most poisonous salt of Hg is mercuric chloride (corrosive sublimate), occurs as colorless masses of prismatic crystals
- Symptoms: Acid metallic taste, hoarse voice, greyish white coating of tongue, blood-stained stool, circulatory collapse, necrosis of jaw, membranous, colitis, proximal renal tubular necrosis, Acrodynia* (Acro-Limbs Odynia-Pain) is seen in mercury poisoning (Pink’s Disease). It is pain, swelling and paraesthesia of limbs
**Minimata disease**—Contamination of fish with mercury, at a place called **Minimate Bay** in Japan.
- **Fatal dose**: 1-4 gm
- **Fatal period**: 3 to 5 days
- **Treatment**
  1. Gastric lavage with (sodium formaldehyde sulphoxylate).
  2. BAL (BAL/MER).
  3. Penicillamine (Pencillamines not given in Arsenic poisoning).

**Chronic Poisoning:** *(Hydrar gyrism)*
- The symptoms are salivation, sore mouth and throat, fine tremors of the tongue, hands, arms, anemia.
- *Shaking palsy* is associated with Hg poisoning. Mercurial tremors are also called *hattter’s shakes or glass blower’s shake.* (Danbury Tremors).

**Mercurial erethism** is seen in persons working with mercury in mirror manufacturing firms. Erethism is characterized by shyness, timidity, irritability, loss of confidence, mental depression, loss of memory and insomnia. *(Psychological symptoms).*

**Mercurialentis** is a peculiar eye change due to brownish deposit of mercury through the cornea on the anterior lens capsule *(Brown-Malt Reflex)*.

It is bilateral and has no effect on visual acuity.

**LEAD (Pb)**

- **Acute Poisoning**: The symptoms are metallic taste, dry throat, peripheral circulatory collapse, paraesthesias, depression, coma and death.
  - In acute poisoning, lead accumulated in liver.*
- **Fatal dose**: Lead acetate 20 gm; lead carbonate 4 gm
- **Fatal period**: 1-2 days
- **Treatment**
The combination of BAL and calcium disodium versenate is effective.

Chronic poisoning (Plumbism or Saturanism)
Inhalation of lead dust and fumes by makers of white lead, smelters, plumbers, glass-polishers.

Chronic poisoning results from a daily intake of one to two mg of lead.

Signs and Symptoms:
A—Anaemia—In early stage polycythemia and later stage Anaemia (Punctate Basophilia).*
Anaemia is due to decrease survival of RBCs and inhibition of haeme synthesis.

B—Basophilic stippling
- Dark blue spots in cytoplasm of RBCs due to disturbance in porphyrin metabolism.

Bartonian line—A stippled blue coloured line present in upper jaw due to lead sulphide.*

C—Colic and constipation (Dry Belly Ache)*

D—Drops i.e. wrist-drop (Radial nerve)
Foot Drop (Deep peronial nerve)

E—Lead Encephalopathy
- More common in children.
- May present as Status Epilepticus.*

F—Facial pallor
- Circumoral facial pallor.
- Most consistent and earliest sign of chronic lead poisoning.

Diagnosis:
- In poisoning, the concentration of lead in blood is usually between 0.1 to 0.6 mg per 100 ml.
- X-ray evidence of increased radio-opaque bands of lines at the metaphyses of long bones is seen in children.
- CPU (Corporoporphyrin in Urine), ALAU (Amino-Laevolinic Acid).*

Treatment:
i. Most effective treatment of plumbism is calcium-disodium versenate.
ii. BAL
COPPER

- It causes Golden Hairs.
- Ptysalism* is seen in copper poisoning: It is copious secretion of saliva.
- Chronic copper poisoning resembles Wilson's Disease (Hepatolenticular Degeneration).
- Clapton's Line → Greenish Line seen on the margins of gums due to formation of Copper Sulphide
  - Fatal dose - 15 gm
  - Fatal period - 1-3 days
  - Treatment:
    i. Stomach wash with solution potassium ferrocyanide.*
    ii. N-penicillamine
    iii. EDTA
    iv. BAL.

LITHIUM

- In chronic poisoning, concentrations between 3 and 4 m mol/l may be associated with severe toxicity.
- Hemodialysis is indicated for severe intoxication.

ZINC

- Metal fume fever or Smelter's fever.
- Zinc toxicity resembles with malarial chills.*

ORGANIC IRRITANT POISONS

RICINUS COMMUNIS

- The castor plant (arandi*) grows all over India.
- Entire plant is poisonous, containing toxalbumen ricin, a water-soluble glycoprotein and a powerful allergen (CBA).
- Ricin is a biological warfare agent.*
- A toxalbumen or phytotoxin is a toxic protein, which resembles a bacterial toxin in action and causes agglutination of red cells with some hemo-
Poisoning: crushed or powdered seeds or an extract is used by criminals for stupefying a victim prior to robbery, rape or kidnapping.
  • Road poison/Railway platform poison.

Mydriatic test: The pupil dilates within half an hour, if datura is present.

CANNABIS SATIVA OR INDICA

• It is also known as Indian hemp, hashish or marijuana.
• The principal constituent of resin of marijuana is Tetrahydro cannabinol.* It is a CNS stimulant.
• It is used in the following forms:
  – Bhang: it is prepared from the dried leaves and fruit shoots (leaves*).
  – Majoon: it is a sweet prepared with bhang.
  – Ganja: it is prepared from the flower tops* of female plant.
• Charas or hashish— it is the resin exuding for the leaves and stems of the plant.

Signs and Symptoms—Large doses cause:
1. Inebriation: the person becomes dreamy or semi-conscious and he has realistic vision, usually of sexual nature e.g. he sees nude beautiful women dancing before him, playing music. It causes psychological high, raises heart rate, delays psychomotor skills.
2. Narcosis: there is giddiness and ataxia, tingling and numbness of the skin, general anaesthesia.

Fatal dose: Charas 2 gm; Ganja 8 gm; Bhang 10 gm/ kilo body weight.

Charas is the most potent preparation of Canabis.

Fatal period: Several days.

Chronic poisoning
• Used in excess, it causes degeneration of CNS.
• There is loss of appetite, weakness, wasting, tremors, vacant look, red eyes, impotence, mental deterioration.
Rarely, they become insane, and may suffer from hallucinations and delusions of persecution.

There may be an impulse to kill.

*Run Amok*: Run Amok is seen in chronic Cannabis consumer. The individual first kills a person against whom he may have real or imaginary enemity and then kills anyone that comes in his way until homicidal tendency lasts. Then he may commit suicide or surrender himself.

**COCAIN**

- It is obtained from leaves of Erythroxylum coca.
- It is used as a local anaesthetic, as a vaso constrictor.
- The usual route of intake is snorting and skin popping.
- Cocain and Heroin in combination is known as Speed Balls (c.f. → knock-out drops which is Chloral-Hydrate).

- *Signs and Symptoms:*
  1. **Stage of excitement**: there is bitter taste, dryness of mouth, depression and fatigue.
  2. **Stage of depression**: within an hour, respirations become feeble, failure or vascular collapse.

- **Fatal dose**: 1-1.5 gm orally
- **Fatal period**: few hours
- **Treatment**: Amyl nitrite is antidote and given by inhalation.

NASAL SWAB is preserved in Cocaine Poisoning because it is SNORTED.

*Cocaine habit*: The patient may suffer from hallucinations, convulsions, delirium and insanity.

*Magnan’s symptoms or cocaine bug* is characteristic, in which there is feeling as if grains of sand are lying under the skin or some small insects are
DELIRIANT POISONS

DATURA FASTUOSA
- There are two varieties:
  - Datura alba—white flowered plant.
  - Datura niger—a deep purple flowered plant.
- The fruits are spherical and have sharp spines (thorn apple).
- Datura stramonium is known as thorn apple.*
- They contain 0.2 to 1.4 of hyoscine (scopolamine), hyoscyamine and atropine.
- Scopolamine is one of the active ingredient of Truth Serum used for Narco-analysis.

Signs and symptoms:
All the important signs and symptoms and Datura starts with Letter 'D'.
1. Dysphagia.
2. Dry and hot skin (hyperpyrexia 103°F body temperature).
3. Diplopia.
4. Dilated pupils.
5. Dilated blood vessels resulting in flushing of face.
6. Delirium:
   - Muttering delirium* is present. Irrelevant taking.
   - Pill rolling movement (also seen in parkinsonism).
   - Carphologia*—picking up of imaginary threads from clothes, bed sheets.
7. Drunken gait.
8. Drowsiness.
9. Death due to respiratory failure.
- Fatal dose: 1 gm (100-125 seeds)
- Fatal period: 24 hrs
- Treatment
  i. Stomach wash with potassium permagnate and weak solution of tannic acid.
  ii. Physostigmine is specific in Datura poisoning.
  iii. Pilocarpine nitrate.
5. When coma is deep-artificial respiration and oxygen is given.

Postmortem appearance:
• Signs of asphyxia are prominent. Froth is seen at the mouth and nostrils.
• The brain, meninges and abdominal organs are congested.
• Postmortem hypostasis: Black coloured.

Chronic poisoning (Morphinism; morphomania):
• Opium addicts can tolerate 3 to 6 gm per day.
• The habitual use first causes a pleasurable feeling of relief and well being, but as larger doses are taken there is disinterest and recurring periods of depression follow.
• Loss of memory, mental fatigue, gradual intellectual, and moral deterioration occur.

Withdrawal symptoms of opioids tend to be opposite to the acute effects of the drug.
Chemical test to detect the presence of opium.
- MARQUIS TEST:
- DENIGES’ TEST:
- HUSEMANN’S TEST

HEROIN (Diacetyl Morphine):
• Also known as: Smack, Brown sugar, Junk, Dope.
• It is white in color.
• “Cutting In”: Term used for adulteration of heroin.
• Substances used for adulterations:
  - Quinidine
  - Mannitol
  - Fructose
  - Talc
  - Chalk powder.
• Heroin + cocaine is called “Speed Balls”.
Opiates exert their effects because of their chemical similarity to natural substances called endorphins.*

- Opioid drugs are capable of producing physical addiction and also psychological and euphoria.
  - Fatal dose: opium 2 gm; morphine 0.2 g
  - Fatal period: 6-12 hours
  - Signs and Symptoms:
    - The contact of morphine with the skin of sensitive persons may cause erythema, urticaria and itching dermatitis.
    - It first stimulates, then depresses and finally paralyses the nerve centers
      - Stage of excitement: There is a sense of well being, increased mental activity, freedom from anxiety, talkativeness, restlessness, hallucinations, flushing of face, maniacal condition.
      - Stage of stupor: The symptoms are headache, incapacity for exertion a sense of weight in the limbs, giddiness, drowsiness and stupor.
      - Stage of coma: The patient passes into deep coma from which he cannot be aroused.
    - The pupils are contracted to pinpoint size and do not react to light, but in late stage they may be found to be dilated.

- Treatment:
  1. The preferred, more definitive treatment for the typical overdose is the narcotic antagonist naloxone I.V.
  2. Stomach wash with a solution of 1:500 potassium permanganate (High concentration).
  3. Atropine is not recommended as it can cause death by paralyzing the motor and sensory nerves like morphine.
  4. N-allyl normorphine (lethidrone or nalorphine) is a specific antidote for morphine codeine, pethidine and methadone.
  5. Nalmefene is one of the latest treatment for opium poisoning.
Legal Limit prescribed by Motor Vehicle act is \(30 \text{ mg}\% \text{ of Blood Alcohol Level (BAL)}\)

- Critical Limit leading to in coordination of Muscles is \(150 \text{ mg}\% \text{ BAL}\)
- Rate of Fall in BAC is \(15 \text{ mg}\% \text{ /hour, Ethyl Alcohol follows Zero order Kinetics}\)
- Sec 510 IPC → Misconduct due to intoxication.

**Methanol Poisoning**

- Earliest clinical presentation is **abdominal cramps**
- It causes snow-field vision, CNS depression, cardiac depression
- Severe non-diabetic acidosis in unconscious person is suggestive of Methanol poisoning
- The toxicity is produced due to formaldehyde and formic acid.
- **Treatment**
  - Haemodialysis is the treatment of choice
- **Antidote**
  - Ethanol
  - 4-Methyl Pyrazole (Fomipazole)
- Folinic Acid enhances excretion of formic acid.

**Post-mortem Findings**

- Marked cyanosis
- Absence of post-mortem clotting
- Haemorrhagic Necrosis of Putaman is seen.

**SOMNIFEROUS POISONS OPIUM**

- **Opium** (afim) is also known as Kasoomba or Madak or Chandu.
- Opium is the dried juice obtained from the poppy (papaver somniferum).
- Opium contains two chemically different groups of alkaloids.
  - The phenanthrenes - morphine 10% codeine 0.5% and the baine 0.3%, which are narcotic.
  - The isoquinolines - papaverine 10% and narco- tine 6% no narcotic property.
- Phaibine an active principle of opium can cause convulsions.
- The artificial derivatives are heroin, dihydro- morphine.
Jellinek's Classification of Alcoholism

- **Alpha** → Taking alcohol to relieve Pain
- **Beta** → Heavy Drinking
- **Gamma** → Sever form, withdrawal symptoms are experienced
- **Delta** → Drinker cannot withstand Dry Spells (Without Alcohol)
- **Epsilon** → Periodically drinking.

**PM Findings**
- Blood fluid and dark.

**Key Points**
- **Widmark's formula**
  - It takes into account size, sex and type of alcoholic liquor
  - It was given by Swedish Toxicologist Eric Prochet Widmark
  
  \[ a = pc_r \]

  \[ r \rightarrow \text{constant and its value is} \]
  - \( 0.6 \rightarrow \text{male} \)
  - \( 0.5 \rightarrow \text{female} \)

  \[ p \rightarrow \text{Body weight} \]
  \[ c \rightarrow \text{Blood alcohol concentration} \]
  \[ a \rightarrow \text{Weight of alcohol} \]

**Tests for Estimation of Alcohol**

- **Macro Method** → Hine and Kozelka method (Color/Spot Test)
- **Micro Method** → Cavett's Test
- **Chemical methods** → based on principle of Reduction of Potassium-bichromate
- **Breath analyser test** is based on Henry's Gas law
- **Gas Chromatography** → most desirable method for medicolegal purpose
- **Tryptophan** metabolism is disrupted in Chronic Alcoholism
CANTHARIDES

Spanish fly (blister beetle) is used externally as an irritant, and is commonly popular as an Aphrodisiac.

- The active principle is cantharidin.
- The Indian fly (beetle) contains about 3% cantharidin.
- Cantharidin is readily absorbed from all surfaces including the skin.

Priapism is an important feature

Fatal Dose: 15 to 50 mg of cantharidin, or 1.5 gm of powdered cantharides.

Fatal Period: 24 to 36 hours.

Alcohol

• Absolute Alcohol 99.5% Alcohol
• Rectified Spirit 90% Alcohol
• Denatured Alcohol 95% Alcohol + 5% wood neptha
• 100 Proof ethanol is 50% Ethanol

Relative concentration of Alcohol at equilibrium

• Blood 1 unit
• Urine 1.3 unit
• Alveolar air .0021 unit
• CSF 1.1 to 1.27

Symptomatology

1. Stage of excitement
   • Alcohol gaze nystagmus
     - Jerking movement in the direction of gaze.
     - Independent of position of head.
     - Average level of 80 mg% cause Alcohol gaze Nystagmus.

2. Stage of Inco-ordination
   • It occurs above 150 mg% or 0.15 (critical level).

3. Stage of Coma
   • McEvans sign is positive.
   • At or above 400 mg% it causes coma.
Blood Stain

Collection:
1. A clean piece of white paper
2. For clothes, some part of non-stained need to be taken
3. Dry stains to be scraped out
4. Liquid blood to be sucked out

Solvents
1. 10% Solt of KCl
2. 10% Solt of Glycerine

Preservation
- Dry the stained article at room temp.
- Air tight containers to be avoided.
D/D of Red stains
- Rust stains: Do not form scales
  - Do not have daster & glazed appearance
- Synthetic dye stain
- Mineral stains
- Vegetable stain: Contains tannin; usually becomes black on adding feces
- Other stains: Resin, grease
- Animal blood
Test for Blood Stain

1. Nature of Stain (Blood or not)
   - Chemical
     - Leichmann’s Haemoglobin Crystal
       - formation of Haemoglobin Crystal
         - NACL + Acetic Acid
     - Takayama Hematochromogen
       - crystal with Takayama reagent
Micro chemical

3. Animal spray test
   for old stains

Principle of micro chemical

* Formation of crystal by heme part of Hb

Chemical test

1. Oxidation of heme → Hematin

   Principle = Peroxidase activity of Hematin

   GOAT
   BPC
   Converting Colorless & salt to Colorful salt by this enzyme in presence of H2O2

4. Benzidine test = Green + Blue

5. Kastle Mayer test = Deep permanganate (Pernsulphate test) colour

6. Chelomycagogue green test = Green

4. Cannic acid test = Blue

5. Kohn test (Orthotoluidine test) = Blue

6. Amido pyrine test = Purple
**Species detection**

**Principle:** Seroology based test

- **Immunological**
  - **Enzyme based**
    - Isoenzyme method
      - Detection by electrophoresis of several isoenzymes

**Principles**

1. **Precipitate**
   - Precipitation of antigen by antibodies

2. **Hemagglutination inhibition test**
3. **Gel diffusion test**
4. **Double diffusion test**
5. **Precipitation Electrophoresis**
6. **Dalex agglutination test**
(3) Blood group (ABO, MNS, Rh) detection

Immunological

Enzyme logic

Determinate

Antibody

Absorption

Inhibition

Mixed Agglutination

Keller

Various blood group systems

Red cell antigens

Serum protein polymorphism

Red cell enzyme polymorphism

ABO

MNS

Rh

Kell

Kidd

Duffy

A, B, C, D, E, F, H, I

A, B, C, E, H

A, B, C, D, E, F

A, B, E

A, B, E

A, B, E

Pgm

Haptoglobin

Transferrin

Adenylate kinase (AK)