Science dealing with properties, actions, toxicity, fatal dose, detection, estimation, treatment and autopsy findings in relation to poisonous substances.
Poison: A substance which when introduced or comes in contact with body or body part prodeuces ill heatlh/death by its effects.

Classification:

1. Corrosives: strong acids/strong alkalies & metallic salts
2. Irritants: causes inflammation of the git & other symptoms
3. Neurotics: act mainly on CNS
4. Cardiac (Digitalis, Oleander, Aconite, Nicotine, HCN)
5. Asphyxiant: CO, CO$_2$, H$_2$S, war gases
Symptoms Suggestive of Poisoning

- Sudden onset of abdominal pain, nausea, vomiting, diarrhea & collapse
- Sudden onset of coma/unexplained coma
- Constriction of pupil
- Sudden onset of convulsions
- Delirium with dilated pupils
- Paralysis (LMN type)
- Jaundice/liver failure
- Oliguria with proteinuria & haematuria
- Persistent cyanosis
# Smell Due to Various Poisons

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Poison</th>
<th>Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>P, heavy metals (As, Se, Thallium), malathion, parathion, alphos</td>
<td>Garlic-like</td>
</tr>
<tr>
<td>2.</td>
<td>Methyl, ethyl, propyl alcohol, acetone, chloroform, nitrites</td>
<td>Fruity smell</td>
</tr>
<tr>
<td>3.</td>
<td>H$_2$S, mercaptans, disulfiram</td>
<td>Rotten eggs</td>
</tr>
<tr>
<td>4.</td>
<td>HCN</td>
<td>Bitter almonds</td>
</tr>
<tr>
<td>5.</td>
<td>ZnP</td>
<td>Fishy</td>
</tr>
<tr>
<td>6.</td>
<td>Carbolic acid</td>
<td>Phenolic</td>
</tr>
<tr>
<td>7.</td>
<td>Organophosphates</td>
<td>Kerosene-like</td>
</tr>
</tbody>
</table>
**DUTIES OF A DOCTOR IN CASE OF SUSPECTED POISONING**

- Note all particulars of patient & confirm his suspicion before expressing an opinion.
- Collect vomitus & urine samples for analysis.
- Carefully observe & record the symptoms
- Consult a senior practitioner in strict confidence & keep him informed about the case.
- Admission to the hospital, obtain informed consent.
- Any suspected article is to be preserved (Non-compliance is punishable under S201 IPC)
- A govt Dr is bound to inform police all suspected cases of poisoning.
- A private practitioner is bound to inform the police/magistrate all cases of homicidal poisoning (Sec 39 CrPC), non-compliance is punishable under S176 IPC.
- A private practitioner is NOT bound to inform the police/magistrate all cases of suicidal/accidental poisoning (Sec 39 CrPC).
- **Sec175 CrPC:** if practitioner is summoned by the IO he is bound to give all information regarding the case. If he conceals the information liable to be prosecuted Sec 202 IPC. If he gives false information then charged under Sec 193 IPC.
Aim is to remove unabsorbed poison.
Most useful within 1 hr. Can be done upto 4-6 hrs after ingestion.
Pt placed in left lateral decubitus position
Attempt insertion of tube (Ewald’s/Boa’s tube), confirm it to be in stomach.
Fluid for Gastric Lavage: NS (KMnO4, NaHCO3, Tannic acid, Saturated lime water, starch solution, NaI or KI may be used)
250 ml of water is injected & allowed to remain few mins then aspirated & preserved for chemical analysis.
Sequentially administering & aspirating 5ml/kg body wt. till clear odourless fluid is obtained.
Aspiration- a common complication (10% of patients)
Oesophageal / gastric perforation- a serious complication.
GASTRIC LAVAGE TUBE
# Contraindications of G. Lavage

<table>
<thead>
<tr>
<th>Contraindication</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosive poisoning (Absolute)</td>
<td>Risk of perforation</td>
</tr>
<tr>
<td>Convulsant poison</td>
<td>May lead to convulsion</td>
</tr>
<tr>
<td>Comatose patient (Relative)</td>
<td>Risk of aspiration</td>
</tr>
<tr>
<td>Volatile poisons &amp; hydrocarbons</td>
<td>Aspiration pneumonitis</td>
</tr>
<tr>
<td>Hemorrhagic diathesis</td>
<td>Risk of h’ge</td>
</tr>
<tr>
<td>Hypothermia</td>
<td></td>
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</tbody>
</table>
ANTIDOTES

- Substance that counteract/reverse/relieve the poisonous effect of a toxic agent.
- **Universal antidote**: Combination of physical & chemical antidote.  
  Powdered charcoal (2 parts) + MgO/milk of magnesia (1 part) + Tannic acid (1 part)  
  [The use of universal antidote declined & is no longer available. Activated charcoal was found superior to it.]

**MECHANICAL/PHYSICAL ANTIDOTE:**
1. Activated charcoal: acts mechanically by adsorbing & retaining the poison within its pores esp. alkaloid poisons then charcoal-toxin complex is evacuated in stools.
2. 40-80 gm given in a soup like mixture & given orally.
3. Each gm of charcoal adsorbs about 100-1000 mg of drug.
4. Contraindications>> ingestion of caustic soda/alkali/aliphatic hydrocarbons/like kerosene/Gasoline, unprotected airways, decreased consciousness and functional or mechanical bowel obstruction
5. Complications: inspissated charcoal may cause bowel obstruction & infarction, mechanical obstruction of the airways.
1. **KMnO₄**: *oxidizes* the alkaloids such as alkaloids (Opium, Strychnine or atropine), barbiturates, phosphorus & cyanide.

2. **Tannic acid**: in the form of strong tea *precipitates* alkaloids, Pb, Ag, Al, Co & Cu.

3. **Dilute alkalis**: Milk of magnesia, alkaline hydroxides, NH₃ will neutralise the acidic toxin.

4. **Tincture Iodine/Lugol’s Iodine**: *precipitates* alkaloids, Pb, Ag, Hg & Quinine.

5. **Common salt**: reacts with AgNO₃ & forms insoluble AgCl.

6. **Albumin**: ppts HgCl₂ & CuSO₄.
Their effect is antagonistic to toxin e.g. Atropine for pilocarpine, amyl nitrite for cyanide, atropine & oximes for OPs etc.

1. BAL (British Anti-lewisite/dimercaprol)
   - Given as 10% solution in oil by i.m. route
   - 3-5 mg/kg i.m.
   - Has 2 sulfhydryl (-SH) groups that bind to heavy metals (As, Au, Bi, Cu, Hg & others).
   - C.i.>> liver dysfunction/damage, G6PD deficient individuals, Cd & Fe poisoning (dimercaprol-Cd & dimercaprol-Fe complexes are themselves toxic).
2. EDTA (Ethylene Diamine tetraacetic acid/CaNa$_2$ Versenate)

- Effective in Fe & Cd including Pb, Cu, Co, & Ni.
- Better than BAL for treatment in As & Hg poisoning.
- Distributed only extracellularly (highly ionised) & excreted in urine by glomerular filtration & carries along with it.
- Given i.v not absorbed by gut & i.m inj is painful.
- 25-35 mg/kg in 250-500 ml D5/NS.
3. d-Penicillamine/Cuprimine

- Has a stable -SH group, hydrolysis product of Penicillin.
- TOC for Cu, Pb & Hg poisoning.
- Also useful in Wilson’s disease.
- D-isomer is used as the L-isomer causes optic neuritis.
- 30 mg/kg body wt orally.

4. Desferreioxamine

- Useful in acute Fe poisoning (hemochromatosis) & transfusional chronic Fe overload.
- 2 g in 5% Laevulose solution given i.v.
5. **DMSA (Dimercapto Succinic Acid)/Succimer**

- Similar to Dimercaprol in chelating properties.
- Water soluble effective orally.
- 10 mg/kg orally 8 hourly.
- Useful in Pb, Hg & As poisoning.
- Superior to EDTA in Pb poisoning.
- Less toxic to kidneys & can be given to G6PD pts.
<table>
<thead>
<tr>
<th>Toxic agent</th>
<th>Specific antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>N-acetyl cysteine</td>
</tr>
<tr>
<td>Anti-cholinergics (Dhatura, Atropa)</td>
<td>Physostigmine</td>
</tr>
<tr>
<td>Anti-cholinesterases (OPs)</td>
<td>Atropine &amp; PAM</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>Flumazenil</td>
</tr>
<tr>
<td>CO</td>
<td>Hyperbaric O$_2$</td>
</tr>
<tr>
<td>CN</td>
<td>Amyl nitrite, Sodium thiosulfate</td>
</tr>
<tr>
<td>Heavy metals &amp; As</td>
<td>Specific chelating agents</td>
</tr>
<tr>
<td>Methanol &amp; Ethylene glycol</td>
<td>Ethanol or fomepizole</td>
</tr>
<tr>
<td>Opioids</td>
<td>Naloxone, naltrexone, nalmefene</td>
</tr>
<tr>
<td>Snake venom</td>
<td>Specific anti-venins</td>
</tr>
</tbody>
</table>
Methods:

1. Forced diuresis & alteration of urine pH:
   - **Saline diuresis**: for alcohol, Fl⁻, & Thallium.
   - **Alkaline diuresis** (Urine pH>7.5): by adding NaHCO₃ to an i.v solution, done for salicylates, phenobarbital, Fl⁻, Mtx, Chlorpropamide.
   - **Acid Diuresis**: for amphetamines, cocaine, local anaesthetics, TCA, Quinidine, Quinine, Strychnine & Sympathomimetics.
2. Whole-bowel irrigation:
- Performed by administering a bowel cleansing solution containing electrolytes & PEG orally by gastric tube at a rate of 2L/Hr until rectal effluent is clear.

3. Cathartics:
- Promote rectal evacuation of GIT contents.
- Are salts (Mg citrate/Sulfate & Sodium sulfate) & saccharides (mannitol/sorbitol).
- Most effective cathartic->SORBITOL (1-2 mg/kg body wt)
- Mg containing cathartics not to be used in renal failure.
- C.i.: Ingestion of corrosives & pre-existing diarrhea.
4. Extra-corporeal removal:

✓ Peritoneal dialysis/hemodialysis, charcoal or resin hemoperfusion, hemofiltration, plasma pheresis & exchange transfusion are capable of removing any toxin from the blood stream.

Dialysis is useful in poisoning with:

✓ Acetone, Br, Cocaine, Cannabis
✓ Alcohols (methyl, ethyl, isopropyl, ethylene glycol)
✓ Salicylates, barbiturates & Chloral hydrate.
✓ Heavy metals (possibly)

Dialysis is NOT useful in poisoning with:

✓ Amphetamines, benzodiazepines, CuSO4, Digitalis & digoxin
✓ OPs & Kerosene oil.
### Sample Preservation

<table>
<thead>
<tr>
<th>Sample</th>
<th>Qty.</th>
<th>Preservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole blood</td>
<td>10 ml</td>
<td>Lithium, heparin or EDTA tube, Fluoride/oxalate if alcohol is suspected</td>
</tr>
<tr>
<td>Urine</td>
<td>20-50 ml</td>
<td>No preservative, NaF is added if alcohol is suspected</td>
</tr>
<tr>
<td>Gastric contents</td>
<td>25-50 ml</td>
<td>No preservative</td>
</tr>
<tr>
<td>Scalp hair</td>
<td>About 100-200</td>
<td>No preservative</td>
</tr>
<tr>
<td>Exhaled air</td>
<td>As reqd.</td>
<td>No preservative</td>
</tr>
<tr>
<td>Scene residues</td>
<td>As appropriate</td>
<td>No preservative</td>
</tr>
</tbody>
</table>
CORROSIVES

- Strong acids- inorganic/mineral acids (H$_2$SO$_4$, HNO$_3$, HCl) & organic acids (oxalic acid, carbolic acid)
- Strong alkalies (NaOH, KOH, K$^+$ Na$^+$ & NH$_4^+$ carbonates)

**VITRIOLAGE:** Throwing of corrosives, H$_2$SO$_4$ most commonly used.

**IPC Sec 326-A:** >10 yrs to life imprisonment+fine (paid to the victim) for voluntarily causing grievous hurt by the use of corrosives

**IPC Sec 326-B:** > 5-7 yrs to life imprisonment+fine for voluntarily throwing or attempt to throw corrosives.

**STRONG ACIDS**

1. GL absolutely c/i can be done in phenol
2. No carbonates/netralizing agents.
3. Give glass of milk/water to dilute & 4 tbsp of Al(OH)$_3$ gel.
4. Give demulcent like olive oil, egg white, starch water, butter
5. Prednisolone 60 mg/kg in divided doses.
6. Correct circulatory shock by i/v fluids & blood products
7. Antibiotics if signs of perforation.
8. Tracheostomy if edema of glottis.
9. NPO i/v route preferred
10. Morphine - to relieve pain
11. Treatment as per symptoms

**MAGENSTRASSE** (street of the stomach): Route of acidic poisons in stomach
PHENOL/CARBOLIC ACID

- Slightly acidic
- Used as an antiseptic/disinfectant
- CARBOLURIA: Metabolised mainly by kidneys into Hydroxyquinone & Pyrocatechol. Presence in urine causes a dark smoky green coloration.
- OCHRONOSIS: Pigmentation of cornea & various cartilages
- Leather bottle stomach: hardening of stomach wall.
- Hemorrhagic nephritis in kidneys.
- 10% FeCl₃ to 10 ml of urine purple/blue colour is formed, persists on heating.
- Cresol gives green colour.
A common toxin through vegetables.
Locally>>corrosive
Systemically
1. CVS>>Shock>>death
2. Extracts tissue calcium>>all findings of Hypocalcemia- tetany, convulsions, coma, death.
   
   **Chvostek/Weiss Sign:** hyperirritability of peripheral nerves.

   **Trousseau sign:** may be positive before other manifestations of hypocalcaemia viz. Hyperreflexia & tetany. More sensitive than Chvostek sign.

3. Renal System>>Tubular necrosis>>Uremia>>Death
STRONG ALKALIES

- Treatment measures same as Strong acids
- Steroid - no benefit & c.i. if esophageal perforation.
- In contrast to SA, esophageal mucosa more severely affected than stomach mucosa.
- Fatal period: 24 hrs
- Fatal dose:
  1. KOH & NaOH: 5 gm
  2. Ammonium carbonate: 30 gm
  3. Sod & Pot carbonate: 15-30 gm
**ARSENIC**

- Metallic As - not poisonous (as it is not absorbed through gut).
- **Toxic Compounds:**
  1. Arsenious oxide/Arsenic trioxide: sankhya/somalkhar>>used in flypapers, rat poisons, weed killers, printing, as mordant in dyes
  2. Copper arsenite (Scheele’s Green) & Copper Acetoarsenite (Paris Green): used as a colouring agent (including confectionary)
  3. Sodium & Potassium Arsenate
  4. Arsenic Sulfide: yellow orpiment (hartal)
  5. **Natural sources**: soil, drinking water, some fishes, mussels & prawns.
  6. Tobacco smoke (cigars), in some beers as impurities.
Present in highest qty in liver>kidney>spleen
Fatty yellow liver.
Found in muscles (for months) & bones, hairs, nails & skin (for years).
Secreted into stomach & intestine even when administered by parenteral routes.
Fatal dose: 120-200 mg of Arsenic trioxide
Arsenophagists can tolerate a dose of upto 300 mg
Fatal period: 1-2 days.
Marsch, Reinsch & Gutzeit tests are obsolete
Red velvetty appearance of gastric mucosa is very characteristic PM finding. Mucosa is covered by thick layer of mucus in which As particles are found.
Demulcents prevent absorption.
Alkalies increase ‘As’ solubility should not be given by mouth.
Antedotum arsenici: freshly prepared Fe(OH)₃ previously used as As antidote is no longer recommended.
<table>
<thead>
<tr>
<th>Feature</th>
<th>As poisoning</th>
<th>Cholera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain in throat</td>
<td>Before vomiting</td>
<td>After vomiting</td>
</tr>
<tr>
<td>Vomiting &amp; purging</td>
<td>Purging follows vomiting</td>
<td>Vomiting follows Purging</td>
</tr>
<tr>
<td>Vomitus</td>
<td>Has mucus, bile &amp; blood</td>
<td>Watery</td>
</tr>
<tr>
<td>Stools</td>
<td>Rice-water with blood</td>
<td>Rice water, no blood passed as</td>
</tr>
<tr>
<td></td>
<td></td>
<td>continuous involuntary jet</td>
</tr>
<tr>
<td>Tenesmus &amp; Anal pain</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Voice</td>
<td>Not affected</td>
<td>Rough &amp; whistling</td>
</tr>
<tr>
<td>Conjunctiva</td>
<td>Inflamed</td>
<td>Not inflamed</td>
</tr>
<tr>
<td>Lab investigation</td>
<td>Radiopaque shadow (X-ray abdomen)</td>
<td>\textit{Vibrio cholera} +nt</td>
</tr>
<tr>
<td></td>
<td>‘As’ in chemical analysis</td>
<td></td>
</tr>
</tbody>
</table>
Mixed sensory & motor neuropathy
Anemia
Rain drop pigmentation: speckled brown pigmentation mainly on the skin flexures, temples, shoulders, eyelids & neck.
Leucomelanosis: macular areas of depigmentation.
Aldrich-Mees lines: hyperkeratosis of palms & soles with irregular thickening of the nails of fingers & toes.
Brittle nails & alopecia also seen.
Chronic exposure also causes diabetes, vasospasm & peripheral vascular insufficiency>>gangrene(Q Black foot disease).