General Toxicology

Dr Melad Gad Paulis

{The dose makes the poison}

Definitions:

 Toxicology is the word derived from the Latin word {Toxicum =poison.

Logy=science} and it means the study the effects of poisonous substances on

living organism.

 Clinical toxicology is the branch of medicine that deals with **forms and**

sources, **mechanism(s) of toxicity**, **toxic dose**, **clinical picture**, **diagnosis** &

treatment of poisoning.

 A poison is any substance that produces harm to the body.

Toxicity may be

- Acute: exposure to a single large dose in short period of time.
- Chronic toxicity: exposure to repeated small toxic doses for large period led to gradual worsening as chronic lead, ethanol toxicity.
- Subacute toxicity: shows the features of acute and chronic toxicity.
- Fulminant toxicity: ingestion of massive dose that produce multiple organ failure.

Classification of poisons:

1. Site of action:

a. Toxin has **local effect**: they act only in the site come in contact with. It has no systemic toxicity. Example of these are corrosives. ... كلور

b. Toxin has **systemic action**: they affect organs away from site of contact i.e., after absorption e.g., morphine, paracetamol…

c. Toxin has **dual action**: it has both local and systemic action. Example is heavy metals.

Target organ classification:

This classification of poison according to the main organ affected by the poison:

I. **Hepatotoxic Agents:**
   - The liver is a target organ for many chemicals and therapeutic drugs, e.g. paracetamol, iron, phosphorous…..

I. **Nephrotoxic agents**: such as aminoglycosides, NSAID, oxalic acid,

II. Agents affecting **nervous system**: as CNS depressants as morphine or stimulants as cocaine or affect neurotransmission as organophosphates.

III. **Cardiotoxic**: drugs as digitalis, aconite.

IV. **Pulmonary Toxic Agents**: as kerosene, chlorine gas.

V. **Gastrointestinal toxic agents**: as food poisoning, heavy metals…

VI. **Dermal**: as corrosives.

VII. **Ocular**: methanol.

3- Origin and source of the poison:

a. Plant origin: as opium, digitalis, strychnine, and atropine.

b. Animal origin: snake and scorpion venom.

c. Synthetic: as barbiturates, paracetamol.

Mode of toxicity:

Exposure to toxin may occur accidentally, homicidal or suicidal.

1. Accidental Poisoning (nonintentional exposure): Low dose or maybe high dose

Most of the poisoning is accidental. In children most of the poisoning is accidental as they consume tablets or syrup in the household accidentally. Accidental poisoning can occur in agricultural workers when spraying insecticides. It can occur if a person drinks unsafe water contaminated with arsenic, etc.

2. Suicidal Poisoning: High dose

It usually occurs by available toxin the victim. Also, it is usually cheap and does not cause pain.

High dose

3. Homicidal Poisoning: intentional giving toxin to a person to induce harmful effect to him.

Toxin used usually has no smell or odour.

Factors which modify the actions of poisons:

1. ***Factors related to the toxin itself***: these factors are

I. **Dose**: as expected increase the dose increase the toxicity. As mentioned earlier poison is a matter of quantity.

II. **Form:** Poisons in gaseous form will act earlier than in other physical states. Poisons in solution act rapidly than the powdered form.

III. **Mode of administration**: Rapidity of action of a poison depends upon the mode of administration. The following are the routes in order of rapidity of onset of action of a poison

- IV injection: is the rapidest route “Then”
- Inhalation “Then”
- IM & SC injection “Then”
- Ingestion “Absorption from m.m. of vagina & rectum is more” “Then” intact skin absorption is the slowest route.

I. **Cumulative effect**: it occurs in toxin with repeated exposure to small doses not enough to cause acute toxicity. Also, drugs slowly excreted from the body as digoxin.

2- Factors related to the patient: it include the following

1. **Age**: Poisons have greater effect on extremes of age.
2. **State of health**: Diseases of kidney and liver increase the effect of most of the poisons as they are the main sites of metabolism and excretion of toxin.
3. **Stomach state**:
   - Amount of food:
   - On empty stomach: poisons have faster action.
   - On full stomach: poisons have slower action.

4. Genetic Condition:

Decrease glucose 6 phosphate dehydrogenase enzymes lead to haemolytic effect of some drug "Even in therapeutic doses" e.g. antimalarial, sulphonamides, vitamin K, naphthalene and benzene.

1. **Hypersensitivity:** In hypersensitive persons may produce severe symptoms even fatal anaphylaxis by therapeutic dose.
2. **Idiosyncrasy**: abnormal response to drug. Morphine In abnormal response may produce CNS excitation.
3. **Tolerance**: it is decreasing the response to the drug in repetition of the dose or increase the dose gradually (Chronic) to obtain the same original response. So persons who tolerated, habituated or addicted to some drugs can stand big doses of these drugs without toxicity e.g. alcohol.
4. **Drug interaction**: in case of ingestion of more than one drug, they may interact to affect action of each other by one of the following:
    1. Synergism: effect of poison increase if combined with another; such as alcohol and barbiturate.
    2. Antagonism: effect of poison is counteracted by another such as ethanol and methanol. (Anti-dote)

General Diagnosis of Poisoning Cases

- **Diagnosis of Poisoning**:

I. History and circumstantial evidences.

II. Clinical manifestations.

III. Investigations.

a toxic case? Comatosed

a- Sudden appearance of toxic manifestations in a healthy person or a group of persons after taking certain food or drink (as food poisoning. methanol and carbon monoxide toxicity),

b- History of intake a poison, financial problems, psychiatric troubles, previous attempts at suicide or threatening by somebody.

c- Presence of bottle of tablets or insecticide near the victim.

d- Patients rescued from fire (CO. cyanide),

GENERAL MANAGEMENT

You must suspect poisoning when the history is inclusive:

- **A comatose patient in whom the etiology is unknown.**
- **Arrhythmias of unknown etiology.**
- **Patients with metabolic acidosis of unknown etiology.**
- **A trauma victim especially if young.**
- **Bizarre symptoms.**
- **Psychiatric patient**

- **I. History: 'SATS"**

Toxic dose (window)

- **S:** substance taken. • **A**: amount ingested.
- **T**: time of ingestion. • **S**: symptoms appeared.

It should include:

- **Route of administration** (i.e., ingestion. intravenous. inhalation).
- **Reason for the ingestion** or exposure (accidental, suicidal, or homicidal.
- Presence of history of psychiatric illness or previous suicide attempts.
- Patient must be asked about **all drugs taken**; including: prescription, over-the-counter medications, vitamins, and herbal preparations.
- Patients may **incorrectly name the drugs** they have ingested; for example; they may refer to ibuprofen as acetaminophen or vice versa.
- Patients can be **unreliable historians**; particularly if suicidal, psychotic, presenting with altered mental status, or under the influence of recreational drugs. In this case information taken from family and friends may also prove helpful.

Examination

Physical Examination

Vital data:

Atropine , anti-histamine , scopium , Calselate aspirin

1. **Temperature:** hyperthermia can occur in salicylate and anticholenrgic poisons, while hypothermia may occur in barbiturates, narcotics, sedative hypnotics and alcohol.

2. Pulse: bradycardia is seen in opiate, digitalis, cholinergic, beta blockers, and calcium channel blockers, while tachycardia occurs in amphetamine, cocaine & anticholenrgic.

3. Blood pressure: hypertension in amphetamine and cocaine.

C. Skin:

1. Flushing: in anticholinergic & alcohol.

2. Diaphoresis: in OPI, salicylate & cocaine.

3. Bullous lesion: in sedative hypnotics especially barbiturate & carbon

monoxide poisoning.

D. Breath: it is important to smell the patient's breath. Alcohol, cyanide, phenol, organ phosphorous and H2S have characteristic odor.

E. Pupil:

1. Pin-pointed: with opiates, OPI, phenothiazines and pontine lesions.

2. Reactive dilated: with sympathomimetics (amphetamine, cocaine).

3. Non reactive dilated: occurs with anticholinergics.

F. Respiratory system:

1. Tachypnea: occur in aspiration pneumonia, toxic hypoxia & CNS stimulants

(amphetamine, cocaine).

2. Bradypnea: occur in CNS depression as in ethanol and barbiturate.

3. Pulmonary edema:

- Cardiac: in beta blockers and cyclic antidepressants.
- Non cardiac: in opiate, barbiturate, OPI & salicylate.

4. Wheezes: in organophosphorous, cholinergic medications and irritant gases.

G. Neurological: careful neurological examination should be done, grading of coma should be assessed in comatose patient.

H. Abdomen:

1. **Vomiting** with Digoxin, Theophylline, OPI.

2. **Diarrhea** with OPI, iron, arsenic. Chronic lead poisoning

3. **Constipation:** with plumbism.

Toxidromes ((Fingerprints) in toxicology)

" A pattern of signs or symptoms that suggests a specific class of poisoning "

I. Anticholinergic toxidrome

Characterictics

-altered mental status (hallucinations, agitation, coma)

-large pupils

- tachycardia, high temperature

--dry flushed skin

-decreased bowel sounds

-urinary retention

Common Causes

-Anticholinergic plants (e.g., Atropa beladona)-

-Atropine

-Antihistamines (Benadryl- Diphenhydramine, Gravol - Dimenhydrinate)

-cyclic Antidepressants

-Antiparkinsonian agents

-Antiemetics

-Antispasmodics

III.Cholinergic toxidrome

Characterictics

-lacrimation, salivation

-bradycardia

-respiratory secretions

-hypoxia

-diaphoresis

-increased bowel sounds

-vomiting

-diarrhea and urinary incontinence

-fasciculations may occur and muscle weakness can result in respiratory failure

Common Causes

organophosphate and carbamate insecticides

II. Sedative hypnotic toxidrome

Characterictics

-depressed mental status

-relatively small pupils

-vital signs usually normal

- **-significant respiratory depression is rare with pure benzodiazepine overdose**
- **-hypotension in large ingestions**

Common Causes

-overdose of benzodiazepines

-some sedative hypnotics

IV.Sympathomimetic toxidrome

Characterictics

-agitated delirium is common

-large pupils

-elevated vital signs

- **-tachycardia**
- **-hypertension**
- **-hyperthermia**
- **-diaphoresis (unless severely dehydrated)**

-bowel sounds present

***Note: This toxidrome is usually differentiated from the anticholinergic toxidrome by the presence of marked diaphoresis (instead of dry skin). Also bowel sounds are not decreased + pallor.**

Common Causes

-overdose of cocaine or amphetamine

-alcohol or sedative hypnotic withdrawal results in similar findings.

Toxidrome	Vital Signs	Signs
Anticholinergic	HR ↑	Bowel sounds ↓ Delirium[a] Dry mouth Mydriasis or normal Skin - dry, flushed
Sympathomimetic	HR ↑ BP ↑	Agitated Delirium[a] Mydriasis Skin—diaphoretic
Opioid	RR ↓ and/or shallow	Bowel sounds ↓ Mental status ↓ Miosis
Sedative-hypnotic	RR normal or ↓[b]	Mental status ↓
Cholinergic	HR ↓	Bronchoconstriction Bronchorrhea Diaphoresis Lacrimation Miosis Salivation Urination

[a]If severe
[b]If combined with other sedatives
BP, blood pressure; *HR,* heart rate; *RR,* respiratory rate; ↑, increased; ↓, decreased.

III. Investigations.

a- <u>Routine investigations</u>:

- **ECG**
- **LFT & Clotting (Paracetamol, anticoagulants).**
- **Arterial Blood Gases.**
- **Urinalysis**
- **Kidney function.**
- **Imaging: x-ray, CT, MRI.**

b- Chemical detection: (Analytical toxicology)

- The most important evidence of poisoning is by chemical analysis.
- Samples are taken from vomitus, gastric lavage, blood, urine and stool.
- Toxicological laboratory screen is important in (Come, Convulsion, Acute Delirium, Metabolic Acidosis & Hypoxia)
- Toxicological Laboratory serum level is important in:- (Alcohol - Aspirin - Paracetamol - Digoxin - Iron - Theophyline - salicylates)
- Carboxyhaemoglobin levels if carbon monoxide poisoning is suspected.