



CLINICAL TOXICOLOGY LAB.

5TH STAGE / 1ST SEMESTER

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Laboratory Principles of Toxicological Screening

ASSIS. LECTURER

ZEENA A. HUSSEIN

NIBRAS J. TAHSEEN

Definition & General Terms:

- is the study of the adverse effects of poisons on living organisms
- Poisons are either chemical or physical agents that produce adverse responses on the biological system
- Any substance can be toxic if introduced in a dose capable of disturbing the normal physiological homeostasis of the exposed body

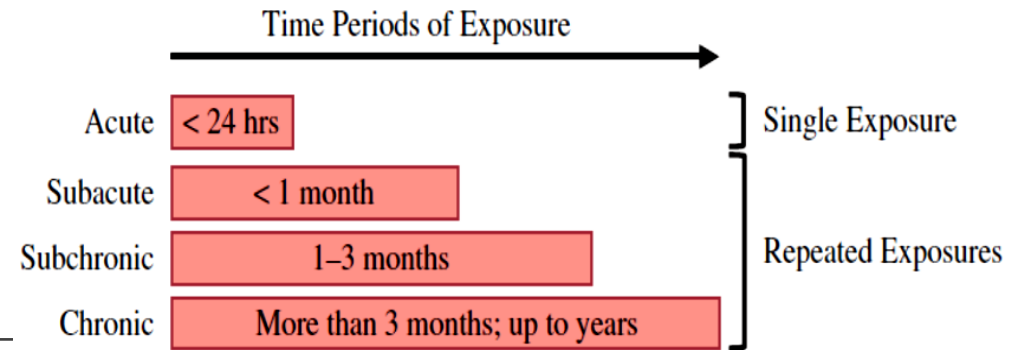
- Toxicants / are toxic substances from chemicals
- Toxins / are poisonous substances produced within living cells or organisms (e.g. venom)

◦ Toxicology is the science of studying toxic substances with respect to their:

- Sources
- Properties
- Mechanism of toxicity
- Toxic effects
- Detection
- Clinical manifestations
- Management



Sources of Toxic Agents:

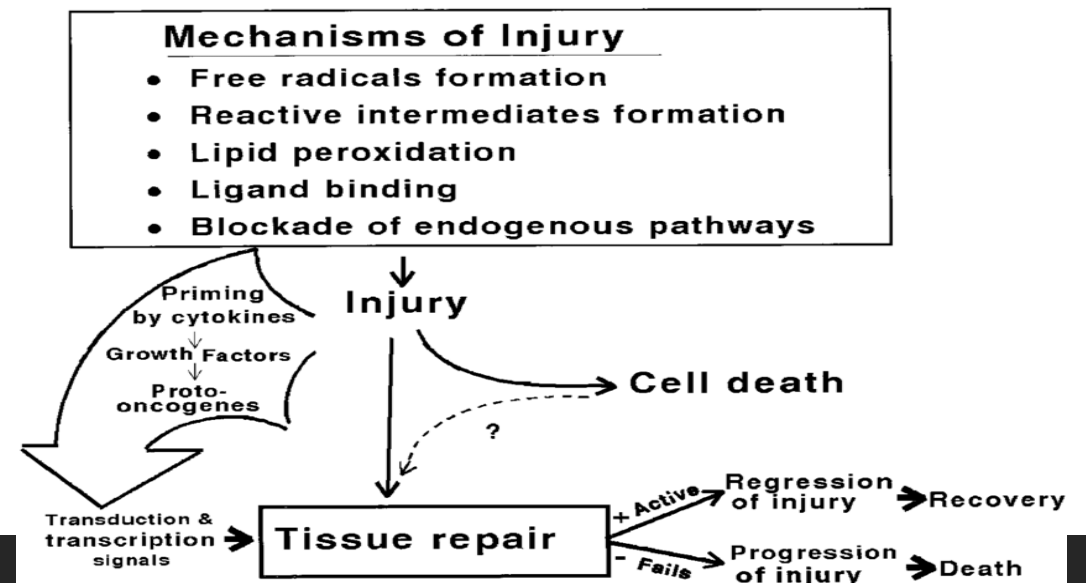


- Chemical sources / e.g. any medication & corrosives (most common)
- Plant sources / marijuana, belladonna, digitalis and among others
- Animal sources / the least but most serious source (e.g., scorpion, spiders, snakes, etc.)

- The duration and frequency of exposure is classified into four categories:
 - Acute exposure: exposure to a chemical for less than 24 hours, with single administration
 - Sub-acute exposure: repeated exposure to a chemical for 1 month or less
 - Sub-chronic exposure: repeated exposure for 1 to 3 months
 - Chronic exposure: repeated exposure for more than 3 months, and some times up to years

Types of Toxic Mechanisms:

- **Direct** / the toxic agents can cause direct toxic effects (e.g.)
- **Indirect** / toxicity results from the interaction of the toxic agent with different pathways within the biological system:
 - ❑ Binding to cell membrane and changing their function or structure, thus affecting normal integrity
 - ❑ Interference with enzymatic reaction
 - ❑ Formation of metabolite of the toxic agents that are more potent and toxic
 - ❑ Effects on the DNA

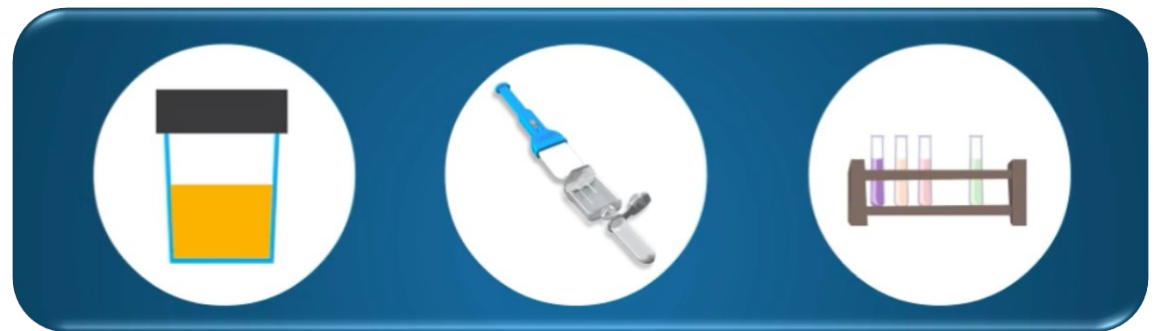


Factors controlling the Toxic Effects:

1. Factors related to the toxic agent:
 - Dose / the basic principle in toxicology
 - Physical status / liquid, solid or gas
 - Purity / presence of impurities, and if the impurities are more toxic than the chemical itself
2. Factors related to the individual: (age, health, sensitivity, and gender)
3. Factors related to the route of exposure: (inhalation, parenteral, topical, and oral)
4. Factors related to the environment: temp., pressure, humidity, and radiation can cause alterations to the toxic agent

Screening Tests:

- Biochemical analysis:
- Hematological analysis
- Qualitative analysis (color indicator)
- Quantitative analysis (measurement of the toxic agent conc.)



Screening Test:

1. Biochemical analysis:

- Serum glucose
 - Hypoglycemia >>> ethanol, paracetamol and salicylates toxicity
 - Hyperglycemia >>> salbutamol, theophylline toxicity
- Plasma enzymes
 - Elevated DLH, AST, ALT enz >>> shock, coma, convulsions
 - Elevated aldolase, CK >>> rhabdomyolysis
 - Serum potassium, uric acid, phosphate >>> acute renal failure
 - GGT activity >>> chronic alcoholism

Screening Tests:

2. Hematological analysis:

- Blood clotting:
 - Elevated PTT >>> snake bites, anticoagulant rodenticides
- Hematocrit (PCV):
 - Low PCV >>> NSAIDs, salicylates toxicity (cause GIT bleeding) >>> hemorrhagic anemia
 - Low PCV >>> chronic arsenic and lead poisoning
 - Low PCV >>> decreased G6PD >>> hemolytic anemia >>> chloramphenicol, chloroquine, primaquine, nitrofurantoin
- Total WBCs count:
 - Leukocytosis >>> ingestion of ethylene glycol & methanol

Screening Test:

3. Qualitative analysis (color indicator):

- **Trinder's test:**
 - Sample >>> urine
 - Uses: detection of salicylate toxicity
 - Changes color to purple or violet
- **Ferric chloride test:**
 - Sample: urine
 - Uses: detection of phenol, phenylbutazone, salicylates toxicity
 - Changes color to purple
- **FPN test (ferric chloride, perchloric acid, nitric acid)**
 - Sample: urine
 - Uses: detection of phenothiazines toxicity
 - Color change from pink to blue
- **O-cresol test:**
 - Sample: urine
 - Uses: detection of paracetamol toxicity
 - Changes color to dark blue or black
- **Dichromate test:**
 - Sample: urine
 - Uses: detection of ethanol poisoning
 - Changes color to green
- **Marquis test:**
 - Sample: urine
 - Uses: detection of opium overdose
 - Changes color from purple to blue
- **Lee-Jones test:**
 - sample: urine
 - Uses: detection of cyanide poisoning >>> color change greenish-blue
detection of salicylates toxicity >>> color change purple
- **Reinch test:**
 - Sample: urine
 - Uses: detection of mercury poisoning >>> silvery deposits
detection of arsenic poisoning >>> purplish-black
- **Meixner Test:**
 - Sample: stool & gastric fluid
 - Detection of certain mushroom toxins >>> color change to blue

Screening Tests:

4. Quantitative Analysis:

- Chromatography:
 - ✓ Thin layer chromatography (TLC)
 - ✓ Gas chromatography - mass spectrometry (GC-MS)
 - ✓ High performance liquid chromatograph (HPLC)
- Immunoassay methods:
 - ✓ Enzyme mediated immunoassay (rapid and accurate), used in emergency cases?
 - ✓ Radio immunoassay
 - ✓ Atomic absorption spectrophotometry
 - ✓ Neutron activation analysis

A top-down view of a wooden desk. On the left is a black alarm clock with a yellow face and numbers. Next to it is a white pen. Below the pen are black-rimmed glasses. On the right is a spiral-bound notebook with a white page. The page has the words "Thank You For Your Attention" written in black cursive script.

*Thank You
For Your
Attention*