Mercury Poisoning
Objectives

• To know the states of Mercury (Hg).
• To understands the Uses of mercury.
• To identify the routes and forms of humans exposure to mercury.
• To classify the routes of absorption, elimination, and tissue deposition of mercury.
• To sort the presentation of mercury poisoning.
• To order the preventive measures.
Mercury poisoning (hydrargyría or mercurialism)

✓ It is a disease caused by exposure to mercury or its compounds.
✓ Mercury (Hg) is a heavy metal occurring in several forms, all of which can produce toxic effects in high enough doses.
✓ Its zero oxidation state $\text{Hg}^0$ exists as vapor or as liquid metal, its mercurous state $\text{Hg}_2^{2+}$ exists as inorganic salts, and its mercuric state $\text{Hg}^{2+}$ may form either inorganic salts or organomercury compounds.
✓ The three groups vary in effects. Toxic effects include damage to the brain, kidney, and lungs.
Uses of mercury

- Mercury is still used in the manufacture of many technical and medical instruments, including sphygmomanometers, manometers, thermometers, and barometers.

- **Amalgam tooth fillings** are widely used in dentistry and can be found in hundreds of millions of people around the world. Amalgam or dental silver is composed of a mixture of 50 percent metallic mercury and metal powder (which is usually composed of silver, tin, copper and zinc in certain proportions).
Uses of mercury

✓ **Organic compounds**: in dusting the grain in agriculture (antifungal)

✓ **Inorganic compounds**: include the nitrate used in certain paints (bottom of ships as antifouling).

✓ In past mercury was used as medical agents e.g. treatment of syphilitic scores after world war II, teething powders given to infants and as diuretic therapy until substituted by frusamide in 1960s.
Human Exposure

✓ Humans are exposed to mercury via many different routes and in different forms.
✓ The general population is primarily exposed to the metal from dental amalgam and the diet.
✓ As a rule, amalgam fillings are the most important source of inorganic mercury and fish are the most important source of methylated or organic mercury.
I. Amalgam fillings

✓ The release of mercury from amalgam fillings is proportional to the number of fillings and the total amalgam surface area.

✓ It has been difficult to accurately estimate the release from amalgam fillings; however, an expert committee from the WHO believes that the average exposure from dental amalgam is approximately 10 µg/day.

✓ Measurements of urinary excretion of mercury have revealed that persons with a habit of tooth grinding release considerably more mercury from their dental fillings than those without this habit.
Human Exposure

II. Exposure from diet

✓ The concentration of mercury is very low in most foodstuffs (below 0.02 mg Hg/kg). However, certain types of marine fish (such as shark, swordfish, and tuna) and certain fish taken from polluted fresh waters may contain high concentrations of mercury.

✓ In this setting, mercury is almost completely in the form of methylmercury (organic). And the concentrations of methylmercury in these fish are 1 mg/kg or even higher.

✓ Severe epidemics caused by the consumption of fish polluted with mercury have been reported from Minamata in Japan.
Human Exposure

III. Occupational exposure

✓ Occupational exposure to inorganic mercury occurs quite commonly in:
  ▪ Dentistry
  ▪ Thermometer factories
  ▪ Mercury mines

✓ Exposure to mercury has significantly lessened during the last few years because of increased attention to minimizing exposure.
Human Exposure

✓ In dentistry, for example, ambient mercury concentrations from 1960 to 1970 were frequently around 25 µg/m³; present values are below 5 µg/m³ due to improved ventilation and handling of amalgam.

✓ Similarly, mercury miners commonly encountered air concentrations of mercury in excess of 100 µg/m³ or even higher. Negative health effects were common at such exposures. This has been lowered to 50 µg/m³ or less in most countries.
IV. Vaccines

Thimerosal, a mercury-containing preservative used in vaccines, is another potential source of mercury exposure. There have been concerns regarding the potential risk to infants and children from exposure to thimerosal-containing vaccines.
Biochemokinetics

The efficiency of absorption, route of elimination, and tissue deposition of mercury depends upon the route of exposure and the chemical form of the metal.

1. **Pulmonary absorption** of mercury vapor is high. The kidney is the major site of deposition for mercury derived from inhalation exposure of mercury vapor. A significant fraction of the mercury vapor taken into the lung is eliminated via exhalation.
Biochemokinetics

2. **Gastrointestinal absorption** of Hg+1 or Hg+2. The kidney is the major site of deposition for mercury derived from inorganic mercury compounds of these valences.

3. **Contact with skin** (all 3 types) → irritation and ulcer. The ulcer is deep and small called “Powder Holes”. Skin contact is rarely absorbed and cause toxicity.

4. Elemental Hg can **cross the BBB and placental barriers**

   Execration by kidneys (mainly), sweat, saliva, expiration and milk.
Acute Poisoning

• It is rare followed accidental ingestion of Hg or inhalation of vapor in industries. It presented with acute febrile illness, cough, dyspnea, tachypnea, nausea, vomiting, lethargy, tightness in the chest, rigor and cyanosis.
• In mild cases → resolve spontaneously.
• In sever cases → hospital admission and respirator.
Mercuric chloride HgCl₂ was common method of suicide in the past, it cause GIT irritation leading to fluid loss and shock and the mercury accumulate in the proximal renal tubules leading to acute tubular necrosis and acute renal failure and death.
Chronic poisoning
✓ It may caused by both inorganic and organic compounds
✓ The most serious effect of chronic Hg poisoning is produced on CNS, oral cavity and kidneys.
✓ The earliest symptoms are vague including dyspepsia and headache. Gingivitis, excessive salivation, the teeth may be drop out, the remaining teeth dark in color and eroded. The gum rarely became dark brown in color → mercury line. Skin lesion includes irritation, dermatitis and powder holes.
Neurological signs:

1. **Tremor** which is neither fine nor regular, it begin as an intention tremor in hands then eye lids, lips and tongue and finally arms and legs. The tremor known as “hatter shake or mad hatter” result primarily from exposure to mercuric nitrate used as carrottting agent in the preparation of animal skin for production of hats.

2. **Spastic gait and ataxia.**

3. **Speech disorder.**

4. **Peripheral poly-neuropathy**: sensorimotor, affecting lower limbs more than the upper limbs. Numbness and tingling in fingers, toes, lips, mouth and tongue.
5. **Other sensory disturbances**: alteration in smell and taste, hearing loss and gross peripheral constriction of the visual field (tube vision).

- Psychiatric disorders: anxiety, neurosis, dementia, apathy and psychotic symptoms.
- Effect on kidneys: mercury concentrate in the proximal renal tubules leading to their damage. 5% have proteinurea and nephritic syndrome is reported.
Preventive measures

1. pre-placement examination.
2. Periodic examination of the workers.
3. Personal protection and ventilation.
4. Personal hygiene.
5. Health education.