

## ETHYLENE GLYCOL

### Introduction

Glycols are dialcohols, poorly volatile, with low toxicity. There is little risk in occupational settings; poisonings are mainly voluntary or accidental involving large quantities (+++ domestic).

**1/ Chemical structure:** 1,2-ethanediol or “glycol” (CH<sub>2</sub>OH–CH<sub>2</sub>OH)

### 2/ Physicochemical properties:

- Viscous liquid, odorless, colorless, sweet taste, slightly flammable, poorly volatile (rarity of intoxication by inhalation).
- Vapor density = 2.14 (air = 1). Boiling point: 197.5°C. Melting point: –13°C.
- Soluble in water and most organic solvents.
- Slightly soluble in ether and insoluble in oils and fats.
- Oxidizable: transformation into acids and aldehydes, as well as reaction with strong bases. Its vapors + air = explosive mixtures.

### 3/ Uses:

Antifreeze in water circuits, hydraulic fluid, in chemical synthesis for the production of glycol ethers, polyesters, explosives, coolant liquid. It is used in the composition of paints, lacquers, varnishes, cosmetics.

### 4/ Etiologies of poisoning:

Voluntary intoxications: suicide attempts, especially in adults.  
Accidental intoxications: confusion with sweet beverages, favored by storage of engine cooling liquids in food-type plastic bottles or lack of awareness of the risk: ingestion by children of refrigerant liquids.

### 5/ Toxicokinetics:

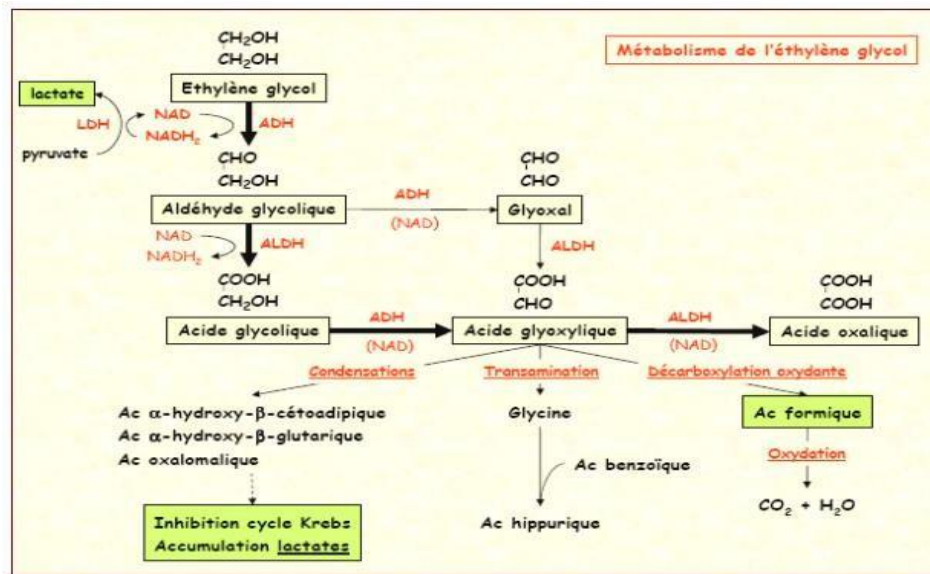
#### Absorption:

Mainly via the digestive route: rapid (<2 h) and complete. Also via respiratory and cutaneous routes in cases of massive exposure.

#### Distribution:

Rapid diffusion throughout the body (+++ liver and kidneys). V<sub>d</sub> = 0.7–0.8 L/kg. Plasma half-life = 3–6 h.

## Metabolism:



## Elimination:

Half-life: 3 h. In urine, the following are found:

- Ethylene glycol in unchanged form.
- Glycolic acid (34–44% of the ingested dose).
- Oxalic acid (2–3%).
- Absence of glycolaldehyde and glyoxylic acid.
- Renal excretion of acidic metabolites may be increased by alkalization of urine.

## 6/ Mechanism of toxic action:

Ethylene glycol: stimulates then depresses the CNS. However, its action is mainly due to its metabolites.

Aldehyde metabolites (glycolaldehyde, glyoxal): central damage (6–12 h)

- Inhibition of protein synthesis and DNA replication
- Reaction with -SH groups of proteins, disruption of oxidative phosphorylation and glucose metabolism

Acid metabolites (glycolic, glyoxylic, formic and lactic): metabolic acidosis

Oxalic acid: formation of calcium oxalate crystals, deposition in the kidneys + hypocalcemia (nephropathy). Presence of crystals in urinary sediment.

## **7/ Clinical features of acute poisoning:**

Lethal dose: 1 mL/kg (child), 1.4 L/kg (adult). It progresses in 3 phases:

### **1st phase (up to 12 h):**

- Digestive disorders (nausea, vomiting, abdominal pain)
- Neurological disorders (agitation, balance disorders, drunkenness-like syndrome, drowsiness, coma, seizures)
- Hyperglycemia
- Hyperleukocytosis
- Hypocalcemia
- Increased anion gap and osmolar gap (>30 mosm/L)
- Metabolic acidosis

### **2nd phase (next 12 h):**

- Tachycardia
- Hypotension
- Circulatory failure and cardiac failure (risk of death)

### **3rd phase (24–72 h):**

- Oliguria
- Anuria
- Proteinuria
- Glucosuria
- Hematuria
- Renal failure that may regress or progress to chronicity

## **8/ Treatment:**

### **Decontamination:**

- Gastric lavage within 2 hours after ingestion. Preferred over ipecac syrup (due to CNS depression).
- Activated charcoal: not useful because ethylene glycol is poorly adsorbed.
- In case of ocular exposure: wash with saline or water.

### **Symptomatic treatment:**

- Correction of acidosis and hypocalcemia
- Intubation and assisted ventilation in unconscious patients
- Benzodiazepines for seizures

### **Extrarenal purification:**

- Hemodialysis (rapid toxin removal and correction of metabolic disorders)
- Peritoneal dialysis is less effective
- Hemoperfusion is ineffective

**Antidote:**

-Ethanol: competitive inhibition of ADH (target blood level 1–1.5 g/L)

Loading dose: 0.6–0.8 g/kg

Maintenance dose: 0.1–0.3 mL/h (monitor glycemia and ethanol levels)

-4-methylpyrazole (Fomepizole): ADH inhibition, longer action and better tolerance

Dose: 15 mg/kg orally or IV over 30 min (loading), then 10 mg/kg every 12 h

**9/ Chronic poisoning:**

-Massive exposure to ethylene glycol vapors:

-Irritation of ocular and respiratory mucosa and neurological disorders (drowsiness, nystagmus)

**10/ Analysis:**

**Sampling:** suspected liquid, gastric lavage fluid, blood, urine

**Detection:**

Enzymatic method (ADH): 0.2–1.5 g/L

Avoid ethanol interference by heating at 100°C for 30 min

Reagent kits: oxidation + colorimetric assay

Gas chromatography with flame ionization

HPLC after benzoyl ester derivatization