

ETHYLENE GLYCOL INTOXICATION

(Last updated October 2020; Reviewer: Alzbeta Glancova, MD; Aysun Tekin, MD; Ognjen Gajic, MD)

PRESENTING COMPLAINT: alteration in level of consciousness, nausea, vomiting

FINDINGS

- A Check airway
- B ↑ RR
- C ↑ HR, ↓/N BP
- D Coma, depressed level of consciousness or seizures might occur
- E Nonspecific
- U_{PC} pulmonary edema
- L_{PC} CBC, ↓ glucose, ↑ lactate, ↓ calcium, ABG: ↓ pH, ↓ CO₂, ↓ HCO₃

* PC: (point-of care)

OTHER HISTORY

Signs & Symptoms:

Depends on the time of exposure to ethylene glycol:

- During the first 12 hours the patient can present with signs of inebriation related to the parent alcohol
- As the parent alcohol is metabolized (12-36 hr) with generation of organic acids, symptoms are characterized by tachycardia, hyperventilation, and muscle spasm
- Calcium oxalate precipitation in the renal tubules (24-48 hr) results in acute kidney injury, and oliguria/anuria
- Delayed neurologic findings (> 1 week after ingestion) include elevated ICP, papilledema, and abducens (CN VI) palsy.

History

- Time from exposure and amount of poisoning are important
- A toxic dose requiring medical treatment varies but is considered more than 0.1 mL per kg body weight (mL/kg) of pure substance. That is roughly 16 mL of 50% ethylene glycol for an 80 kg adult and 4 mL for a 20 kg child
- Poison control centers often use more than a lick or taste in a child or more than a mouthful in an adult as a dose requiring hospital assessment
- The orally lethal dose in humans has been reported as approximately 1.4 mL/kg of pure ethylene glycol. That is approximately 224 mL (7.6 oz.) of 50% ethylene glycol for an 80 kg adult and 56 mL (2 oz.) for a 20 kg child.

Predisposing Conditions:

- Exposure can be through ingestion inhalation, or dermal penetration from automotive antifreeze and de-icing solutions, windshield wiper fluid, solvents, cleaners, and fuels.

DIFFERENTIAL DIAGNOSIS

- Metabolic acidosis
- Methanol intoxication
- Ethanol intoxication

OTHER INVESTIGATIONS

- **Labs:**
 - Fingertick glucose to rule out hypoglycemia
 - ABG, electrolyte panel CBC, ethylene glycol level, serum lactate, ketones, serum osmolarity, urinalysis with microscopy for calcium oxalate crystals
 - Calculation of osmolar gap – commonly used surrogate marker but neither sensitive nor specific. A normal osmolar gap cannot exclude ethylene glycol poisoning

- **Imaging:**
 - Chest X-ray for signs of pulmonary edema
 - CT scan for cerebral edema.

THERAPEUTIC INTERVENTIONS

General:

- Airway protection, consider intubation in patients severely intoxicated.
- If patient is hypotensive give IV fluids, followed by vasopressors if needed.
- Ethylene glycol is rapidly absorbed and does not bind to activated charcoal. As a liquid, gastric lavage and whole bowel irrigation have no role in management.

Antidotes:

- Give fomepizole or ethanol if;
 - Ethylene glycol on serum is >20 mg/dL, or history of ingesting toxic amount of ethylene glycol and serum osmolality gap >10 , or strong clinical suspicion of ethylene glycol poisoning and at least 2 of the following:
 - Arterial pH <7.3
 - $\text{HCO}_3^- < 20$ mEq/L
 - Osmolar gap >10
 - Oxalate crystals present on urine.
 - Fomepizole 15 mg/kg IV loading dose followed by 10 mg/kg q12hr x 4 doses; at that point, increase dose to 15 mg/kg IV q12hr. Dosing schedule should be increased to Q4hr if patient receiving hemodialysis.
 - If patient is allergic to fomepizole or it is unavailable give ethanol 10 ml/kg of a 10% of ethanol solution, followed by 1 mL/kg of 10% ethanol solution infused per hour. Titrate to serum ethanol concentration of 100 mg/dL.
- Adjunctive antidotes include thiamine 100 mg IV daily and pyridoxine 100 mg IV daily.
- Sodium bicarbonate should not be routinely administered and reserved for patients with severe metabolic acidosis, as a temporizing measure prior to hemodialysis.
- If patient presents with seizures, treat with benzodiazepines.

Contact/Consult:

- American Association of Poison Control at (800)222-1222, 24 hours, 7 days a week
- Nephrology consultation

ONGOING TREATMENT**Follow-Up:**

- Monitor serum ethylene glycol
- Monitor lactate, ABG
- Urinalysis for oxalate crystals
- Monitor urine output- Renal function (creatinine)

Manage Complications:

- Hemodialysis:
 - Metabolic acidosis, regardless of drug level
 - Elevated ethylene glycol levels >8.1 mmol/L, unless arterial pH is above 7.3
 - Evidence of end-organ damage (e.g.: renal failure)

CAUTIONS

- Complications:
 - Irreversible severe renal failure
 - Death

REFERENCES & ACKNOWLEDGEMENTS

This card was originally developed by Author: Reddappa Kanipakam, MBBS; Reviewers: Namita Jayaprakash, MD, Matthew D. Sztajnkrycer, MD, PhD

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