

# Ethylene glycol (EG) toxicity

Extended Version

**Classic case:** Dog, acute onset lethargy, disorientation, vomiting, seizures. Hx of anti-freeze exposure

**Presentation:** VERY COMMON

- All animals susceptible
  - **Cats highly sensitive**, 1 teaspoon can be fatal
  - **Dogs** most frequently exposed
- Sources
  - Car radiator fluid (**ANTIFREEZE #1**)
    - Puddle under car when leaks or after change
    - Found in toilets of cabins in Northern hemisphere to prevent freezing over winter
  - Antifreeze also found in
    - Aircraft deicing products
    - Portable basketball posts
    - Windshield wiper fluids
    - Paints
    - Photography developer solutions
- Risk factors
  - Outdoor, free range, garage access
  - Northern colder climates
  - Water sources for pets are frozen
  - Ethylene glycol does not freeze and is sweet tasting
  - Summer radiation flushing
  - **Engine leak (MOST COMMON)**
- Clinical signs - **Triphasic**
  - **Stage one: 30 min – 12 hrs**
    - **CNS** signs
      - Lethargy, disorientation, ataxia, knuckling
      - Vomiting, PU/PD, hypothermia, hypotension
      - Seizures, coma, ± muscle fasciculations (grave prognosis)
  - **Stage two: 12 – 24 hrs**
    - Appears to have improved
    - Quiet, depressed, PU/PD
  - **Stage three: 24 – 72 hrs**
    - Weakness, depression, anorexia, tachypnea/dyspnea



*Beloved pets drink from puddles.*

*Image courtesy Robert Couse-Baker*

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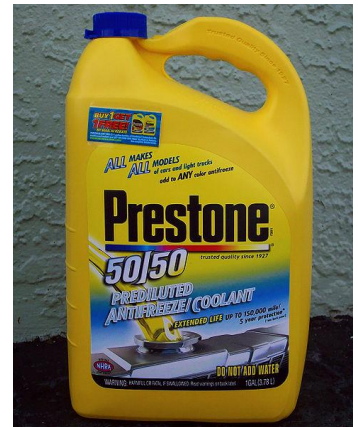
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## DDX:

Encephalitis, cranial trauma, intracranial neoplasia, pancreatitis, gastroenteritis, ketoacidotic diabetes mellitus, renal failure, other toxicities (barbiturates, aspirin, methanol, isopropanol, propylene glycol, raisins, grapes, NSAIDs, lilies)

## Test(s) of choice:

- **REACT™ Ethylene Glycol Test Kit**
  - False positives from propylene glycol, glycerol, sorbitol, mannitol, or thimerosal
  - Do not use isopropyl alcohol to disinfect area before blood draw
  - **Fomepizole** may block a positive result
  - Propylene glycol is found in some injectables, activated charcoal suspensions
- Serum osmolality: requires colloid osmometer
  - > 20 mOsm/kg strongly suggestive of ethylene glycol toxicity
- Chemistry
  - Increased BUN, creatinine, glucose, phosphorus
  - Hypo- or hypercalcemia
  - High anion gap metabolic acidosis
    - Anion gap =  $(\text{Na}^+ + \text{K}^+) - (\text{Cl}^- + \text{HCO}_3^-)$
    - > 25 mEq/L significant for diagnosis
- Urinalysis
  - Glucosuria, cellular casts, cells (renal tubular, transitional, squamous)
  - Monohydrate calcium oxylate crystalluria – 3-18 hrs post ingestion
    - Picket fence crystals
- Wood's lamp
  - Detects fluorescein stain in antifreeze
  - Scan muzzle, paws, vomitus, urine – supports exposure
- Ethylene glycol and glycolic acid levels in serum or urine
- Ultrasonography
  - 4 – 6 hours: increased cortical echogenicity
  - Later: Halo sign indicating anuria. Grave prognosis



Antifreeze



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## Rx of choice:

### Immediate treatment for EG toxicity is critical

*“Due to rapid progression and irreversibility of renal lesions, **any patient suspected** of consuming EG **should be tested and decontaminated** unless/until exposure has been ruled out;*

***empirical treatment with fomepizole or ethanol is indicated if the index of suspicion is high and a confirmatory test is not available in time.***

*The greatest window of opportunity for intervention is <8–12 hours post exposure in dogs, <2 hours post exposure in cats.”*

Cote, Clin Vet Advisor, Dog and Cat. 2<sup>nd</sup> ed. pp. 369-71

- Supportive care (IV fluids, NaBicarb CRI, treat seizures, warmth)
- Decontaminate
  - Induce vomiting if within 4 hours and conscious
  - Activated charcoal
  - ± gastric lavage – under anesthesia
- **Prevent metabolism of ethylene glycol** into toxic metabolites
  - Fomepizole (4-methylpyrazole, 4-MP, Antizol-Vet)
    - Inhibits alcohol dehydrogenase
    - Can cause sedation and hypothermia
    - **DOGS:** 20 mg/kg slow IV infusion Then 15 mg/kg slow IV q 12 h x 3
    - **CATS:** Label dose is NOT effective
      - Must use **higher, OFF-label dose in cats**
      - Cats <3 hours after ingestion at 125 mg/kg slow IV infusion, then 31.25 mg/kg q 12 h x 3 treatments has shown significant success
  - 7% Ethanol (Dogs)
    - Competes with alcohol dehydrogenase
    - Enhances diuresis
    - Increases CNS depression
  - 20% Ethanol (Cats)
    - If > **3 hours** since ingestion of EG by a cat, ethanol is the treatment choice
  - Hemodialysis (most effective) or peritoneal dialysis
    - Eliminate ethylene glycol and metabolites from circulation
    - Concurrently with 4-MP or ethanol
    - Only option for pregnant animals

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## Prognosis:

Good: Dogs treated within 5 hours, cats within 3 hours

Guarded to poor: Very large doses presenting with seizures, nystagmus

## Prevention:

- Do not keep animals in the garage
- Lock antifreeze containers away from chewing dogs
- Immediately clean spills or leaks with cat litter

## Pearls:

- Renal tubules regenerate over time
- Ethylene glycol itself is not toxic
  - **EG is metabolized** by liver to toxic metabolites via alcohol dehydrogenase
  - Glyoxalate, glycolate, oxalate
    - Calcium oxalate crystal formation in renal tubules and microvasculature
    - Renal tubular damage
    - High anion gap metabolic acidosis
    - Citric acid cycle inhibition
    - Phosphorylation inhibition

**Refs:** Cote, Clin Vet Advisor, Dog and Cat. 2<sup>nd</sup> ed. pp. 369-71; Merck Vet Manual 10<sup>th</sup> ed (online): Ethylene Glycol Toxicity.

## My Notes: