Diethylene glycol

CAS*:* 111-46-6
MF: $C_4H_{10}O_3$
MW: 106.12
log Kow=-1.47
Solubility: Miscible with water, alcohol, ether, acetone, ethylene glycol [1].

Major use
In antifreeze solvent for sprinkler systems, for water seals, for gas tanks; brake fluid; lubricating and finishing agent for wool, worsted, cotton, rayon and silk, solvent for vat dyes, humectant for tobacco, synthetic sponges, paper products; in cork, glues, gelatin, casein compositions; and book-binding adhesives etc [1].

Human toxicity
Initial symptoms may include nausea, vomiting and headache; with continued use, severe abdominal pain, polyuria followed by oliguria, anuria and renal failure. Unlike ethylene glycol, hepatotoxicity is common [2].

Lethal symptoms: liver necrosis, renal tubular degeneration [1].

The central nervous system (CNS) and respiratory depression, including drowsiness, coma, demyelinating lesions of the central and peripheral nervous systems, respiratory arrest and pulmonary edema has preceded death in reported cases. Tremors and rare seizures may accompany uremia. Most fatalities have resulted from epidemic exposure due to contaminated medication in a setting with limited access to intensive medical care. Delayed onset of symptoms (vomiting 2 days post-ingestion and acute renal failure 6 days post-ingestion) has been reported in several fatalities. Death normally occurs from sudden cardio-respiratory arrest. Pulmonary edema may develop. Tachypnea often occurs secondary to acidosis [2].

The acute lethal dose of diethylene glycol for humans has been estimated at ~1 ml/kg [1, 2]. Adults who ingested sulfanilamide contaminated with diethylene glycol survived doses of 1 to 240 ml (of a 72% solution).The average fatal dose in people who drank a sulfanilamide elixir with diethylene glycol as the vehicle was approximately 1 ml (72% concentration of diethylene glycol) per kg body weight [2].

In three fatal acute poisoning cases, blood concentrations of diethylene glycol ranged from 0.22 to 27 mg/l [3].

Kinetic data
No kinetic data for humans are available.

Metabolism and excretion
The main metabolite is 2-hydroxyethyloxyacetic acid (HEAA).

Toxicological mechanisms
The mechanisms of toxicity are unknown. Insignificant increases in calcium oxalate excretion can be demonstrated in animals, but not in humans. The mechanism of renal injury is presumably different from that of ethylene glycol. It has been suggested that

hygroscopic swelling of parenchymatous cells causes obstruction of the kidney tubule lumen [2].

The HEAA may be the mediator of neurotoxicity in humans. Although the exact mechanism of diethylene glycol neurotoxicity has not been described, the following possible mechanisms for its cellular toxicity were proposed: transcellular fluid shifts, membrane destabilization through phospholipid or ion channel effects; metabolic acid-base derangements, and osmotic metabolite accumulation within cells [2].

Target organs: kidney, liver.

References

1. HSDB, TOXNET (2005).
2. Poisindex, Thomson Micromedex (2006).
3. Ferrari, L.A., Giannuzzi, L. (2005) Clinical parameters, postmortem analysis and estimation of lethal dose in victims of a massive intoxication with diethylene glycol. Forensic Sci Int 153, 45-51.

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