POISON CONTROL

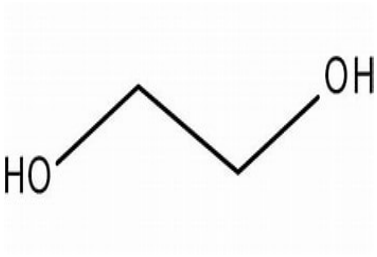
VOLUME 1

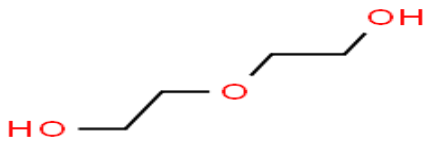
An Overview Of Ethylene And Diethylene Glycols Poisoning, Treatment And Management

The National Agency for Food and Drug Administration and Control (NAFDAC) with this write-up aims to give a brief overview of ethylene and diethylene glycol poisoning and describe treatment and management strategies following incessant cases of infant and child mortality resulting from presence of these contaminants in paediatric remedies as reported by WHO and other regulatory bodies across the globe.

Ethylene glycol (EG) and diethylene glycol (DEG) are produced from same starting material; ethylene. The difference between them is that an ethylene glycol molecule is an individual molecule whereas diethylene glycol molecule is formed by the combination of two ethylene glycol molecules via an ether bond. They have closely related structures.

STRUCTURES





Ethylene glycol C2H6O Diethylene glycol C4H10O

Ethylene glycol and diethylene glycol are organic compounds that have a wide range of applications. They are used in the production of coolants for engines (brake fluid, antifreeze, lubricants), wallpaper strippers, mold release agents, inks, and multiple other products. Most of these products are clearly labelled "harmful, if swallowed".

Ethylene glycol and diethylene glycol as poisons

Ethylene glycol and Diethylene glycol exposure poses risks to human health because of widespread industrial use and accidental exposures from contaminated products. They are among several toxic alcohols that have medical and toxicological importance, the other principal ones are methanol and isopropanol. Both glycols if ingested and left untreated can result to fatal outcomes.

Most of the documented cases of ethylene glycol and diethylene glycol poisoning have been wide-spread in nature, where either of the glycols was used as substitute for more expensive, but nontoxic glycols in pharmaceutical preparations.

They are also commonly present as impurities in **propylene glycol** (predominantly used in cosmetics and pharmaceutical products as excipient approved by FDA). Propylene glycol is a vital excipient for increasing the solubility and stability of prescribed and over-the-counter medicines. Moreover, propylene glycol helps maintain moisture in specific medicines and topical formulations such as creams due to its ability to absorb water. The FDA traditionally considers Propylene glycol safe. However, toxic impurities such as ethylene oxide, 1,4-dioxane, ethylene glycol and diethylene glycol are commonly encountered depending on the synthetic route employed during the polymerization process.

Toxic Effect of Ethylene glycol and Diethylene glycol Ingestion

Ethylene glycol and diethylene glycol are toxic to human health, there harmful effect may result in coma, seizures, metabolic acidosis and renal failure.

Both are rapidly absorbed following ingestion, which is the predominant route of exposure. Ingestion of the glycols lead to systemic toxicity beginning with CNS effects, followed by cardiopulmonary effects, and finally renal failure.

The progression of toxic effects can be roughly divided into the following three stages, although overlap is possible. The first phase consists of gastrointestinal symptoms with evidence of inebriation and developing metabolic acidosis. If poisoning is pronounced, patients can progress to a second phase with more severe metabolic acidosis and evidence of

emerging renal injury, which, in the absence of appropriate supportive care, can lead to death.

Treatment and Management

Initial treatment consists of appropriate airway management through assisted ventilation while giving attention to acid-base abnormalities. Prompt use of fomepizole or ethanol is important in preventing the formation of the toxic metabolite HEAA; (N-(2-Hydroxyethyl)acrylamide). Hemodialysis can also be critical.

Persons who have swallowed large amounts of ethylene glycol or diethylene glycol should be hospitalized. Treatment is generally successful if begun within 3 hours of exposure, and most people recover completely after treatment. Once severe acidosis and renal failure have occurred, however, hemodialysis is necessary.

Traditional treatment consists of administration of sodium bicarbonate to temporarily correct the metabolic acidosis, ethanol, and hemodialysis. Fomepizole is a new agent with a specific indication by the U.S. Food and Drug Administration for the treatment of ethylene glycol poisoning. Ethanol and fomepizole are thought to act as inhibitors of alcohol dehydrogenase and therefore prevent the formation of acidic ethylene glycol metabolites, but only fomepizole has demonstrated this ability.

Fomepizole treatment should be initiated immediately when ethylene glycol poisoning is suspected. Within three hours of initiating therapy with fomepizole, inhibition of metabolite production and resolution of acidosis occurs, and the anion gap is normalized within four hours. If fomepizole therapy is begun before a rise in the serum creatinine concentration, damage to the kidney can be avoided. When compared with ethanol, the advantages of fomepizole include a slower rate of excretion by the kidneys, lack of CNS depression or hypoglycemia, and easier maintenance of effective plasma levels. The biggest drawback is the cost of the antidote as treatment of ethylene glycol poisoning with fomepizole, estimating an average of 3.5 doses, costs about $3,000 per patient.

The above treatment strategies are effective in most cases, but if treatment is delayed, renal failure and death can occur.

For those **paediatric patients** who do show signs of ethylene glycol or diethylene glycol poisoning, the diagnostic and treatment considerations described above for adults largely apply.

Reference

1. Ethylene Glycol Toxicity Medication: Antidotes, Nutrients (medscape.com)
2. Ethylene Glycol | Medical Management Guidelines | Toxic Substance Portal | ATSDR
3. Diethylene glycol poisoning - PubMed
4. file:///C:/Users/PC/Desktop/FDIC/How%20Should%20Patients%20Exposed%20to%20Ethylene%20Glycol%20Be%20Treated%20and%20Managed_.html
5. Feb 4, 2021: How does Diethylene Glycol differ from Ethylene Glycol? | Tennessee Poison Center | FREE 24/7 Poison Help Hotline 800.222.1222
6. https://www.medicinejournal.co.uk/article/S1357-3039(07)00289-7/fulltext#relatedArticles
7. https://www.differencebetween.com/difference-between-ethylene-glycol-and-vs-diethylene-glycol/
8. https://www.aafp.org/pubs/afp/issues/2002/0901/p807.html