

Project: Ghana Emergency Medicine Collaborative

Document Title: Toxic Alcohols

Author(s): Pamela Fry, MD

License: Unless otherwise noted, this material is made available under the terms of the **Creative Commons Attribution Share Alike-3.0 License**:
<http://creativecommons.org/licenses/by-sa/3.0/>

We have reviewed this material in accordance with U.S. Copyright Law **and have tried to maximize your ability to use, share, and adapt it.** These lectures have been modified in the process of making a publicly shareable version. The citation key on the following slide provides information about how you may share and adapt this material.

Copyright holders of content included in this material should contact **open.michigan@umich.edu** with any questions, corrections, or clarification regarding the use of content.

For more information about **how to cite** these materials visit <http://open.umich.edu/privacy-and-terms-use>.

Any **medical information** in this material is intended to inform and educate and is **not a tool for self-diagnosis** or a replacement for medical evaluation, advice, diagnosis or treatment by a healthcare professional. Please speak to your physician if you have questions about your medical condition.

Viewer discretion is advised: Some medical content is graphic and may not be suitable for all viewers.

for more information see: <http://open.umich.edu/wiki/AttributionPolicy>

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }



Public Domain – Government: Works that are produced by the U.S. Government. (17 USC § 105)



Public Domain – Expired: Works that are no longer protected due to an expired copyright term.



Public Domain – Self Dedicated: Works that a copyright holder has dedicated to the public domain.



Creative Commons – Zero Waiver



Creative Commons – Attribution License



Creative Commons – Attribution Share Alike License



Creative Commons – Attribution Noncommercial License



Creative Commons – Attribution Noncommercial Share Alike License



GNU – Free Documentation License

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }



Public Domain – Ineligible: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }



Fair Use: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.

Ventilated Patients

Checking the “A” in ABC....

Troubleshooting the Mechanical Airway

- Try the mnemonic “DOPES”
 - D = displacement
 - O = obstruction
 - P = pneumothorax
 - E = equipment failure
 - S = sedation



Toxic Alcohols

Pathophysiology and
Emergency Management

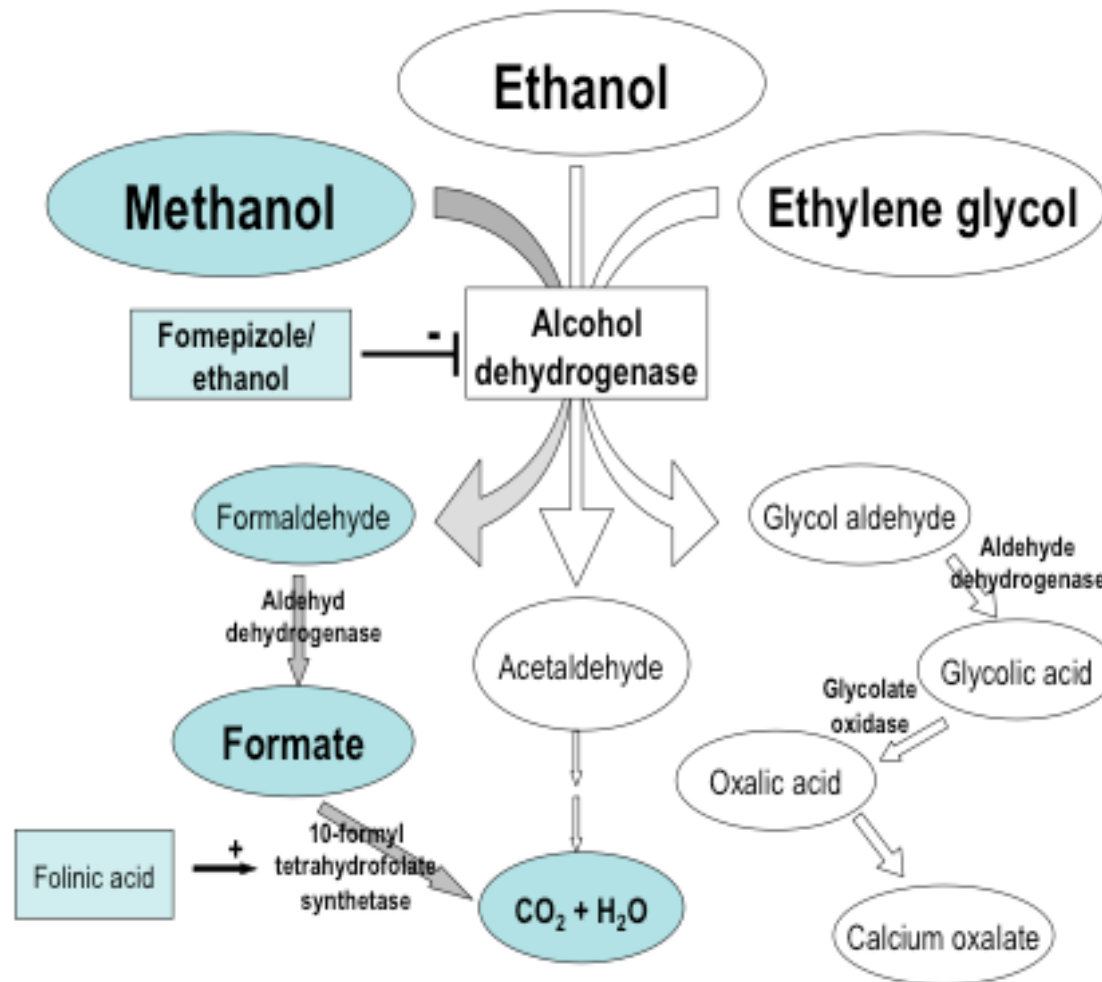
What are the toxic alcohols?

- Methanol
- Ethylene Glycol
- Isopropanol

Methanol

- ◉ Where is it found?
 - ◉ Wiper fluid/de-icing products
 - ◉ Paint thinners
 - ◉ Shoe dye
 - ◉ Embalming fluid
 - ◉ “Moonshine”
- ◉ How are patients exposed?
 - ◉ Primarily ingestion
 - ◉ Possible from dermal or inhalation exposure

Methanol and metabolism



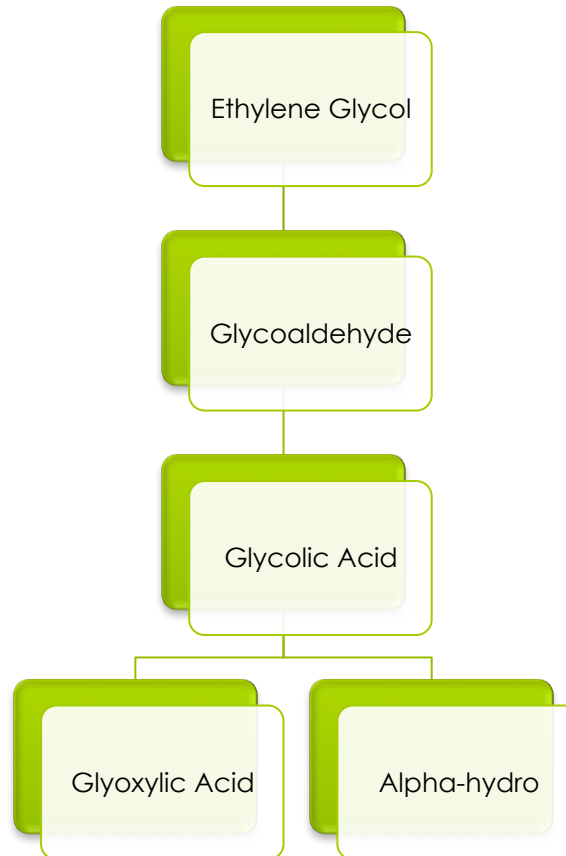
Methanol

- Metabolism leads to acidosis
 - Formic acid buildup
 - Lactic acidosis
- Effects of formic acid
 - Direct optic and retinal toxicity
 - Shifts cells to anaerobic metabolism by inhibiting cytochrome oxidase

Ethylene Glycol

- Where is it found?
 - Radiator anti-freeze
 - Degreasing agents
 - Metal cleaners
- How are patients exposed?
 - Primarily ingestion: no odor, no color, sweet taste

Ethylene Glycol Metabolism



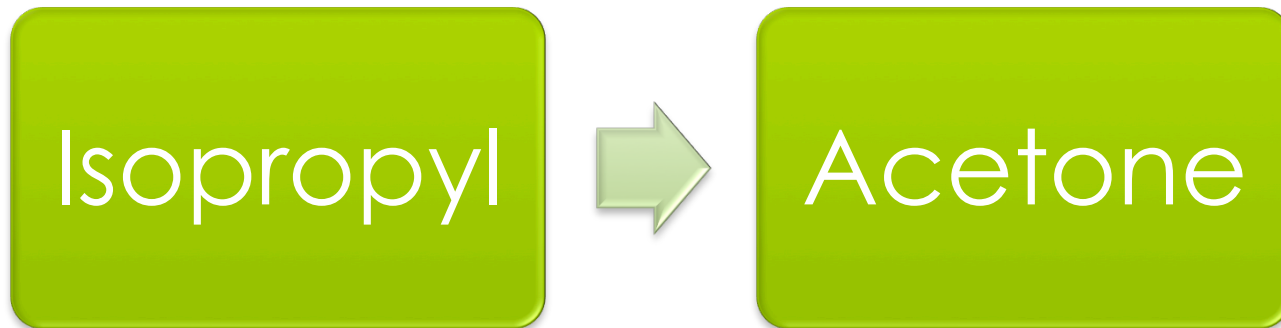
Ethylene Glycol

- ◉ 80% hepatic metabolism
- ◉ 20% excreted unchanged in the urine
- ◉ Half-life depends on renal function
- ◉ Also causes acidosis
 - ◉ Directly from glycolic acid, glyoxylic acid, oxalic acid
 - ◉ Indirectly when NAD⁺ depletion leads to anaerobic metabolism → lactic acidosis

Isopropanol

- Where is it found?
 - Rubbing alcohol
 - Hand sanitizers
 - “Spirits”
- How are patients exposed?
 - Primarily ingestion
- Most common in USA
- Less toxic than other alcohols

Isopropyl Metabolism



Methanol

- ◉ Least inebriating
- ◉ First 24hrs (direct effects of methanol)
 - ◉ CNS depression
 - ◉ Euphoria/ mild inebriation
- ◉ Later symptoms (from formic acid)
 - ◉ Visual changes
 - ◉ Blurred vision, decreased acuity, photophobia, “snowstorm” vision
 - ◉ Progresses to blindness, absent papillary response, permanent optic nerve atrophy
 - ◉ Parkinsonian symptoms
 - ◉ Abdominal pain

Ethylene Glycol

Stage	Symptoms
1: Neurological (0.5-12 hours)	<ul style="list-style-type: none">• Initial: intoxication, euphoria• After 4 to 12 hours, if ingestion is severe: CNS depression, seizures, meningismus, nystagmus, ataxia, ocular external muscle paralysis, hyperreflexia, muscle spasms, hypocalcemia
2: Cardiopulmonary (12-24 hours)	<ul style="list-style-type: none">• Tachycardia, mild hypertension, hyperventilation (secondary to metabolic acidosis)• Acute respiratory distress syndrome, congestive heart failure, cardiac dysrhythmia (secondary to hypocalcemia and QTc prolongation)
3. Renal (24-72 hours)	<ul style="list-style-type: none">• Oliguria, flank pain, acute renal failure• Renal failure (typically reversible)• Bone marrow suppression

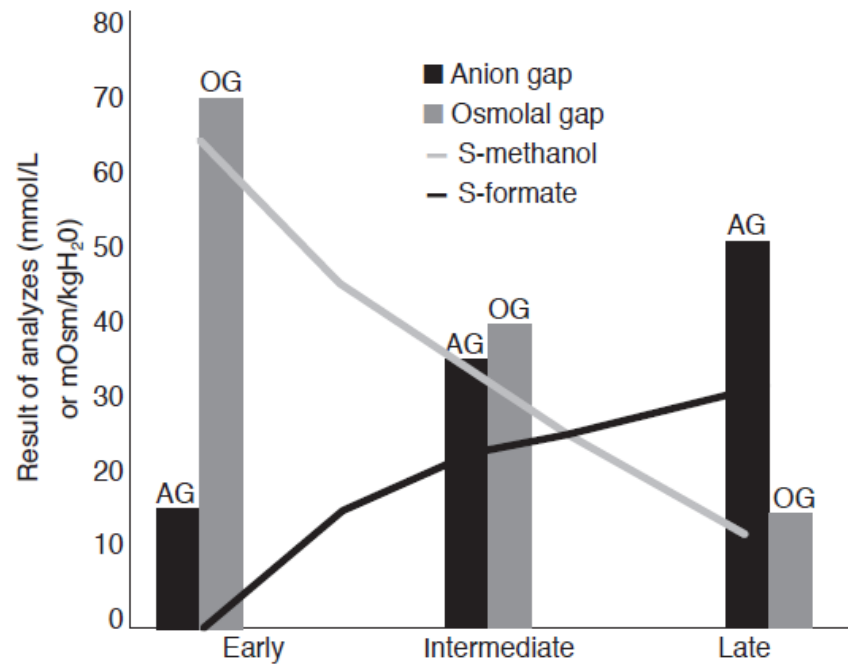
Isopropanol

- Fruity odor on breath
- Gastrointestinal
 - Abdominal pain
 - Nausea/vomiting
 - Upper GI bleeds
- Neurologic
 - CNS depression (may progress to coma)
 - Nystagmus
 - Ataxia
 - Confusion

Diagnostic Evaluation

- All laboratory based – difficult to obtain promptly in Ghana
- Labs all from same sample:
 - Electrolytes
 - Osmolality
 - Ethanol level
 - Toxic alcohol levels

Evaluating Labs



Abbreviations: AG, anion gap; OG, osmolar gap.

Evaluating Labs

- Calculate serum osmolality

$$\text{Osmc} = [2 \times (\text{sodium})] + (\text{BUN}/2.8) + (\text{glucose}/18) + (\text{ethanol}/4.6)$$

- Measure serum osmolality
- Calculate osmolar gap
- Calculate anion gap
- Check urine for calcium oxalate crystals
- Definitive: toxic alcohol concentration

Evaluating Labs

- ◉ Ethylene glycol:
 - ◉ Hypocalcemia
 - ◉ Renal failure
 - ◉ Low bicarbonate
- ◉ Methanol:
 - ◉ Low bicarbonate
- ◉ Isopropanol
 - ◉ No anion gap
 - ◉ Falsely elevated creatinine

Treatment Algorithm

One or more of the following criteria:

- anion gap >12
- osmolar gap >10
- ethylene glycol >20 mg/dL
- methanol >20 mg/dL
- Evidence of metabolic acidosis
- Evidence of renal failure

Administer
fomepizole 15 mg/kg
(Class II)

Ethylene glycol

Methanol

Treatment Algorithm

Ethylene Glycol



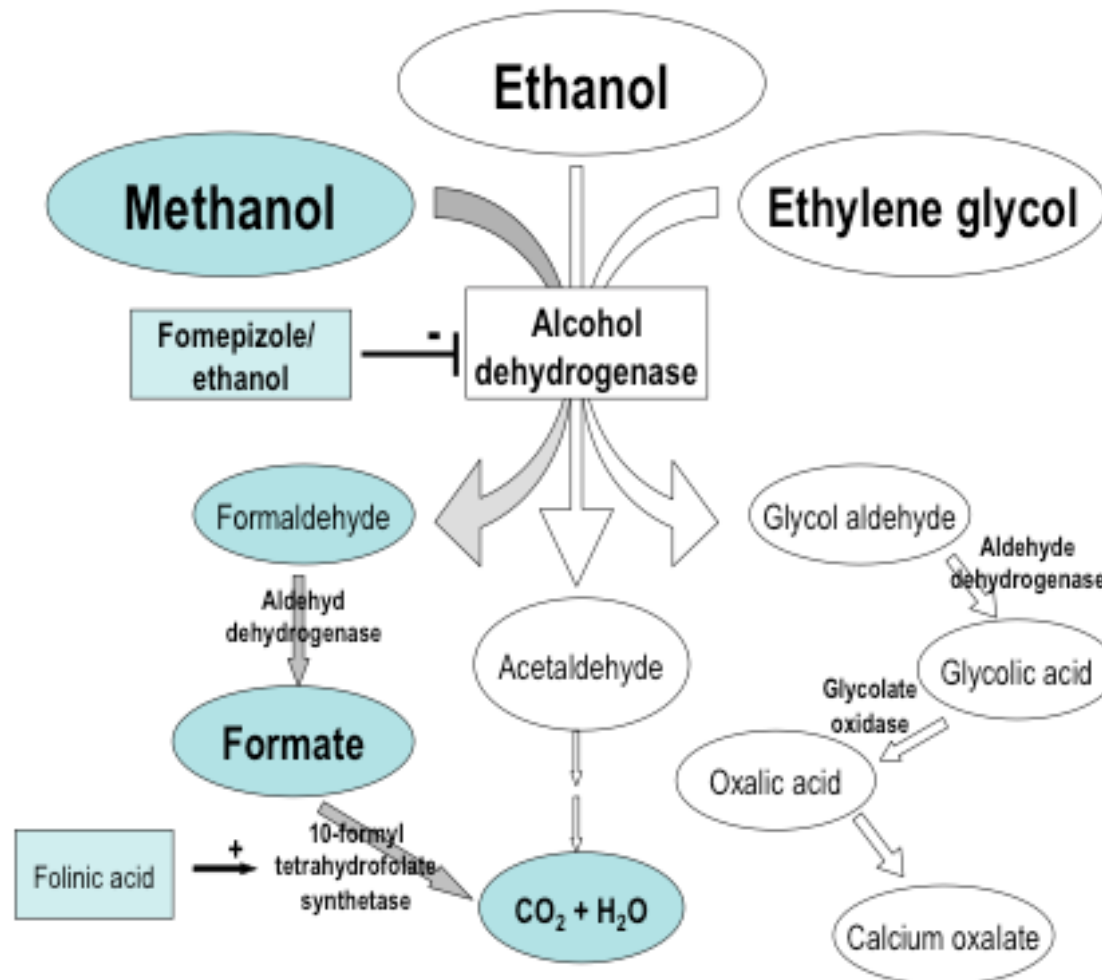
1. Administer thiamine 100 mg IV AND administer pyridoxine 100 mg IV (Class III)
2. Order renal consult if:
 - presentation is delayed
 - patient is acidemic
 - there are signs of renal insufficiency
3. Admit to ICU

Methanol



1. Administer folinic acid (leucovorin) 50mg IV OR administer folic acid 50 mg IV (Class III)
2. Order ophthalmologic consult
3. Consider renal consult for potential hemodialysis if:
 - ingestion is large
 - presentation is delayed
 - there are visual disturbances
3. Admit to ICU

Toxic Alcohol Metabolism



Treatment

- Airway, Breathing, Circulation
- Consider gastric aspiration
 - Only for LARGE ingestions
 - Only if VERY recent (<1 hour)
- Activated charcoal for coingestions
- Antidote
 - Fomepizole: \$1,000 per vial; 15 mg/kg dose
 - Alcohol: used since 1940s with success

Treating with Alcohol

- Higher affinity for ADH
 - 68x greater than ethylene glycol
 - 15x greater than methanol
- IV or PO formulations available
- Goal: blood alcohol between 100 and 150mg/dL

Treating with Alcohol

- IV: 10% ethanol in D5W
 - 60-80 mg/kg loading dose
 - 80-130 mg/kg/hr maintenance
- PO: 20% ethanol
 - Mix with orange juice
 - 80 mg/kg loading dose
 - 80 mg/kg/hr maintenance
 - Chronic Alcoholics: 150mg/kg/hr

Treating with Alcohol

- Side effects
 - Hypoglycemia (90% of patients)
 - CNS depression
 - Intoxication
 - Thrombophlebitis
 - Hypotension
- Frequently require modifications in infusion rate to maintain 100mg/dL blood level
- Should be admitted to ICU

Pediatric Considerations

Children who ingest more than a taste of ethylene glycol or any amount of methanol are referred by poison control centers to the ED for evaluation.

In children 18 months to 4.5 years of age, a mouthful is between 5 and 10 mL and could potentially result in concentrations that exceed 20 mg/dL of either toxic alcohol.

No guidelines are currently available from the AACT or the AAPCC for treating children with toxic alcohol ingestion. In addition, the FDA has not officially approved fomepizole for use in children. Several case studies and case series report the administration of fomepizole to pediatric patients. Fomepizole is preferred over ethanol in children, since they are at risk for hypoglycemia (secondary to poor glycogen stores), hypothermia, and CNS depression.

Treating Isopropanol Ingestions

- VERY DIFFERENT from other toxic alcohols
- Inhibiting ADH will make the patient worse!
- ABCs
- Administer PPI (hemorrhagic gastritis)
- Supportive care
- Consider co- ingestions

Conclusions

- Consider treatment if pt symptomatic (inebriated) or witnessed significant ingestion
- Don't forget cofactors!
- Consider dialysis (only needed acutely)
- If treating with alcohol, monitor carefully for hypoglycemia
- Remember: osmolar gap first, anion gap second