

# EM CASE OF THE WEEK

BROWARD HEALTH MEDICAL CENTER DEPARTMENT OF EMERGENCY MEDICINE



Toxic alcohols include methanol and ethylene glycol. These toxins are found in antifreeze, moonshine, and some windshield washer fluid. If left untreated, toxic alcohols can cause significant morbidity and mortality.

## EM CASE OF THE WEEK

EM Case of the Month is a monthly “pop quiz” for ED staff. The goal is to educate all ED personnel by sharing common pearls and pitfalls involving the care of ED patients. We intend on providing better patient care through better education for our nurses and staff.



## Toxic Alcohols

*EMS and Police bring a 25-year-old male into the ED for agitation and paranoia. Patient was running down the aisles of Publix with a butcher knife. He drank two bottles of Nyquil while in Publix and was presumably under the influence of Flakka. His vital signs are T 100.8, HR 120, RR 20, BP 110/70, O2 sat 98% and he is paranoid that everyone is trying to hurt him. He is sedated and labs are drawn. He is found to have a large anion gap metabolic acidosis. A work up is started to further investigate the cause of the anion gap metabolic acidosis. What is the next step in his management?*

- A. Give him activated charcoal because it is likely he ingested something
- B. Admit him to the hospital and let the admitting physician worry about the cause
- C. Order additional lab tests to further investigate the cause of the increased anion gap metabolic acidosis
- D. Don't do anything because this is normal for people taking Flakka



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## Anion Gap Metabolic Acidosis

- MUDPILES
  - Methanol
  - Uremia
  - DKA
  - Propylene glycol, Paraldehyde
  - Infection, Iron, Isoniazid
  - Lactic acidosis
  - Ethylene glycol, Ethanol
  - Salicylates

## Take Home Points

- In an unknown toxic ingestion, the clinician must determine if there is an anion gap metabolic acidosis
- Consider all aspects of MUDPILES when cause of increased anion gap metabolic acidosis is unknown
- When considering toxic alcohols an osmolar gap must be calculated to help determine if a toxic alcohol has been ingested
- Treatment of ingestion of a toxic alcohol includes Fomepizole, Ethanol, and in the worst case scenarios dialysis

## Increased Anion Gap Metabolic Acidosis: Toxic Alcohols

**The correct answer is C.** Investigation into the cause of an increased anion gap metabolic acidosis could mean life or death. It is crucial to find out the cause so that it can be corrected and treated appropriately. There are multiple causes of an increased anion gap metabolic acidosis and each one must be looked at closely and considered especially when the cause is not apparent. If the increased anion gap metabolic acidosis cannot be explained by ketones, lactate, renal failure, or salicylates empiric treatment for toxic alcohol poisoning may be initiated. For this case we will be focusing on the work up and management of toxic alcohol ingestion.

### *Discussion:*

### **Methanol:**

**Clinical presentation:** Every year, methanol and ethylene glycol intoxications cause dozens of deaths in the United States. Methanol is found in many American households and in the drink moonshine. It is commonly found in windshield wiper fluid, antifreeze, and glass cleaner. Usually intoxication will present with nausea, vomiting, and abdominal pain. There is a latent period up to 24 hours after ingestion and then respiratory difficulty and weakness will occur. Patients may also complain of visual disturbances which they describe as “walking in a snowstorm.” Coma, seizures, and death can also occur. A widened osmolar gap and anion gap metabolic acidosis is present. The pH can be lower than 7.0 in these patients.

**Pathophysiology:** The degree of toxicity correlates with the amount of methanol ingested. Toxicity results when ADH converts methanol to formaldehyde. Formaldehyde is then degraded by aldehyde dehydrogenase to formic acid. After ingestion patients can also have parkinsonian like side effects.

*(cont'd next page)*

*For a list of educational lectures, grand rounds, workshops, and didactics please visit*

*<http://www.BrowardER.com>*

*and click on the “Conference” link. All are welcome to attend!*

### Ethylene glycol:

**Clinical presentation:** Ethylene glycol is a component of radiator antifreeze, coolants, polishes, and cleaners. After ingestion there is a 4-12 hour latent period until toxic metabolites are made. There are three distinct phases that effect the body when ethylene glycol is ingested. It depresses the central nervous system, it causes cardiorespiratory toxicity, and also nephrotoxicity.

Ethylene glycol affects the central nervous system more then methanol and you can see its affects 30 minutes to 12 hours after ingestion. Signs and symptoms include stupor, nausea and vomiting, seizures, and hallucinations. Effects on the cardiorespiratory system can be seen within 12-24 hours after ingestion. The patient will have hypotension, tachypnea, congestive heart failure, and sometimes myositis. The last phase occurs 24-72 hours after ingestion and is the renal phase. The patient will have flank pain and oxalate crystalluria. In worst-case scenarios the renal phase will progress to oliguria requiring lifelong dialysis.

**Pathophysiology:** ADH converts ethylene glycol into glycoaldehyde which is then converted glycolic acid rapidly. Then glycolic acid is slowly converted to glyoxylic acid. The two key metabolites created are oxalate and glycine. Hypocalcemia can be a common laboratory finding in these patients. Pyridoxine can be given to these patients to shift the production of oxalate to the less toxic metabolite glycine.

**Diagnosis:** Once the patient is found to have an increased anion gap metabolic acidosis not explained by causes such as ketones, lactate, renal failure, or salicylates the work up for toxic alcohol ingestion must begin. One of the first steps is determining the calculated osmolarity using the formula  $2(\text{Na}) + \text{BUN}/2.8 + \text{glucose}/18 + \text{ethanol}/4.6$ . Next an osmolar gap must be calculated using the formula  $\text{Osm-Oc}$  which is the difference between measured osmolarity (which is measured by the lab) and calculated osmolarity.

Typically an osmolar gap less then 10 rules out toxic alcohol poisoning, but even if the gap is less then 10 and the suspicion is high the patient could still have toxic alcohol poisoning. For ethylene glycol the urine may have oxalate crystals revealing ingestion. Unfortunately, it takes awhile to get the results of methanol and ethylene glycol in the serum so these other methods must be used if suspicion is high.

**Treatment:** Gastric lavage with an NG tube can be useful in the first 1-2 hours following ingestion. Activated charcoal is not useful in these patients. The affinity of ethanol to ADH is greater then ethylene glycol and methanol so giving it will saturate ADH binding sites and will prevent it from metabolizing ethylene glycol and methanol to its toxic metabolites. Fomepizole (aka 4-methylpyrazole, "4-MP") reversibly inhibits ADH. It is rapidly effective and can be used parenterally or orally. It does not cause inebriation or hypoglycemia seen with ethanol. Once ADH is blocked the half-life of methanol and ethylene glycol increases and hemodialysis must be used. The indications for hemodialysis include confirmed overdose with metabolic acidosis, renal compromise, visual disturbances with methanol, or high serum concentrations of the toxic alcohols. Sodium bicarb is only used is the pH drops below 7.2 in these patients. In ethylene glycol poisoning pyridoxine and thiamine may decrease oxalic acid formation and shift metabolism to less toxic metabolites. Recommended doses are 100 mg administered daily. In methanol poisoning it is thought that folate can be used to enhance the elimination of formic acid.

**Prognostic factors:** It has been found that coma, seizures and a PH of 7.0 were the factors found to be associated with a high rate of death. It has also been found that prolonged acidosis has been correlated with increased neurologic sequelae. Shorter time to dialysis does not improve survival.

Reference: Methanol and ethylene glycol poisoning: A case study and review of current literature. (n.d.). Retrieved April 22, 2015, from <http://www.cjem-online.ca/v4/n1/p34#Discussion>

### ABOUT THE AUTHOR:

This month's case was written by Stephanie Bromante. Stephanie is a 4<sup>th</sup> year medical student from NSU-COM. She did her emergency medicine rotation at BHMC in April 2015. Stephanie plans on pursuing a career in Internal Medicine after graduation.