Management of Suspected Diethylene Glycol (DEG) Ingestion in a Child
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Introduction: A 4-year-old boy with no significant past medical history presents to the ED after being found playing in the garage. His parents are concerned for a possible ingestion of brake fluid but the child is asymptomatic.

Vital Signs: BP, 109/71 mm Hg; HR, 130 beats/min; RR, 24 breaths/min; T, 97.4°F; O₂ Sat, 97% (RA)

Past History: None

Exam: Healthy, well-appearing 4-year-old, normal physical examination

Laboratory Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST</td>
<td>37 U/L</td>
</tr>
<tr>
<td>ALT</td>
<td>16 U/L</td>
</tr>
<tr>
<td>pH</td>
<td>7.37</td>
</tr>
<tr>
<td>PCO₂</td>
<td>46</td>
</tr>
<tr>
<td>HCO₃</td>
<td>26.6</td>
</tr>
<tr>
<td>O₂ Sat</td>
<td>97%</td>
</tr>
<tr>
<td>Lactate</td>
<td>0.9 mmol/L</td>
</tr>
</tbody>
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Osmolality: 292 mmol/L

Calculated Osmolality = 284 = 2 [136] + [15] + [117] + [0]

Osmol Gap = 8 = 292 - 284
Anion Gap = 17 = 136 mEQ/L - 99 mEQ/L - 20 mEQ/L

Hospital Course: Brake fluid may contain varying percentages of diethylene glycol (DEG); for example Preston Hi-Temp Brake Fluid® can contain 1% to 60% DEG. Due to the increased anion gap, the patient was administered a loading dose of fomepizole six hours post-ingestion. The child was observed in the pediatric intensive care unit for the development of possible DEG toxicity and to repeat the laboratory studies including anion gap, osmol gap, and venous blood gas. Final follow-up lab work after fomepizole was stopped revealed an anion gap of 8 and osmol gap of 6. Subsequent blood toxic alcohol testing which resulted 5 days later was negative for methanol, ethylene glycol, and isopropyl alcohol. A serum DEG concentration was not obtained.

Diethylene Glycol: This solvent is used in brake fluid but its contamination of pharmaceutical preparations has resulted in mass-poisoning disasters including sulfanilamide elixir (1937), acetaminophen syrup (1995), and most recently in craft beer (2020). Toxicity from DEG typically results in acute kidney injury (AKI) followed by neurologic dysfunction including bilateral cranial nerve VII (facial) nerve palsy, peripheral extremity weakness and permanent encephalopathy is possible. The accumulation of the metabolite 2,2-oxybisacetic acid (DGA) of DEG is believed to be primarily responsible. Treatment includes fomepizole (based primarily on animal data) to block metabolism of DEG and hemodialysis (HD) in patients with clinical evidence of toxicity or renal impairment. In one case study, DEG was detectable in serum specimens prior to HD and was undetectable after a single session of HD. Apparent elimination half-lives of DEG vary considerably depending on the ingested dose and patient renal function and range between 6 to 13 hours. The minimal toxic dose of DEG in humans is unknown.

Discussion: The case described here was unlikely to be a toxic ingestion of DEG since the child consistently had a normal mental status (indicating likely trivial ingestion or non-exposure) and did not develop any worsening metabolic acidosis or any evidence of clinical effects. At most hospitals in our area, it takes several days to obtain
blood toxic alcohol concentrations and a blood DEG concentration is even more difficult to obtain due to the rarity of its testing. However, DEG can clearly cause consequential side effects including AKI and severe neurologic manifestations. Patients with suspected DEG toxicity should be treated with fomepizole and subsequent hemodialysis to remove the toxin if there is a high clinical suspicion of a significant ingestion. Consultation with your regional Poison Control Center (or local toxicologist) is recommended for assistance and advice on evaluation and management.

References:
Dias, Murillo. (2020). Fatality, Malpractice, or Sabotage? Case on Craft Beer Poisoning in Minas Gerais, Brazil. 3. 26-31. 10.36349/EASJMB.2020.v03i01.04.
http://www.saigulf.com/SDS/Prestone%20Synthetic%20Brake%20Fluid%20SDS.pdf
Emma Furlano, MD is a first-year Medical Toxicology Fellow at the New York City Poison Control Center. She graduated medical school from Stony Brook University and completed residency in Emergency Medicine at Albany Medical Center. Her current interests include poison center research, medical education, and dialyzable toxins.