

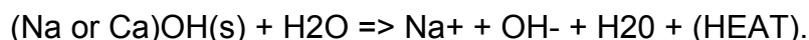
The Spurned Nip: A “Caustic Cocktail”

“The rebreather training was going great. The student’s initial apprehension of diving CCR was fading. Buoyancy control was not an issue anymore and even the drills started to feel like “second nature”. But on day four during a shore dive, one of the students experienced the “caustic cocktail”. Fortunately, she recognized her problem and bailed-out as she was trained to do. Unfortunately, she was unable to completely spit out the mix and swallowed some of it. Back on shore, the student complains of burning in her mouth and chest. Swallowing is quite painful. While one staff member is calling an ambulance, an other is handing her a can of Coke. She is being told to drink it as it would neutralize the alkali mix in her mouth, throat and esophagus. Taking little sips, she is swallowing with discomfort. Luckily, she has no difficulty breathing. None of the corrosive mix seems to have made it onto her vocal chords or into her lungs causing laryngo- or bronchospasm. In that scenario, she would not have been able to breathe. The ambulance arrives. After a quick exam by the paramedics, she is taken to the Emergency Room for further evaluation.”



What is a Caustic Cocktail?

When CO₂ absorbent, such as Calcium or Sodium Hydroxide, gets wet it turns into a corrosive liquid that is alkaline (vs. acidic):



External contact is usually less serious than internal exposure which can be life threatening. The more caustic the mixture, the more potentially serious the injury. The concentration of the alkaline solution is a function of how much water gets in contact with how much absorbent.

Complications

External contact on the skin, may result in some “minor” burns.

Contact with the eyes needs to be treated immediately and medical attention should be sought.

If ingested, it can cause a chemical burn from the entry point all the way down to the stomach. Once it hits the acidic environment in the stomach, the alkali gets neutralized.

If inhaled, it can cause a reflex laryngeal (upper airway) or bronchial (lower airway) spasm. Breathing during the spasm may not be possible. Subsequent complications include developing a chemical pneumonitis[1] or prolonged respiratory distress as in Adult Respiratory Distress Syndrome (ARDS).

First Aid

Alkalis produce liquefactive necrosis[2] that can cause deeper tissue penetration – more significantly than thermal burns. Unlike acidic burns that can be more easily treated with briefer flushing with water, alkaline burns need to be flushed for a much longer period of time because it burns much deeper into tissues.

Skin

Promptly flush with lots of fresh water. Coke, Pepsi or vinegar is okay, too if there is no open wound. Those products are mildly acidic and may help neutralizing the hydroxide. [3]

Eyes

Immediately irrigate with copious amounts of fresh water. EMS needs to be activated. Keep flushing the eye until EMS arrives. DO NOT flush with anything but fresh water! Using an acidic solution may cause damage in this case.

Ingestion

If any caustic material gets into your mouth, try to spit it out and avoid swallowing. Try to rinse your mouth as soon as feasible. Once at the surface, keep flushing with water. If Coke or Pepsi is available, rinse and SPIT with it.

If some of caustic material was swallowed and you are not nauseated, you may want to attempt to sip some Coke or Pepsi in an attempt to neutralize the hydroxide. You cannot “flush” your esophagus, but reducing the burn by neutralizing the caustic material may help. If too nauseated however, don't ingest. If the victim is not conscious or appears confused, don't push it on him/her.

Inhalation

Get the diver out of the water quickly. He/she may have severe difficulty breathing and unconsciousness may occur. As soon as possible, activate EMS. Provide oxygen, if possible. As the diver may vomit, lay him/her onto his/her side to prevent potentially inhaling the vomit. Rescue breathing may have to be initiated. Stay with the diver and provide supportive care with oxygen until EMS arrives and takes over.

Subsequent aid

Eyes

Eye burns of any type are considered an emergency and require immediate treatment. Pain medications, topical anesthetics, and cycloplegic agents (to restrict movement of eye muscles) are almost always necessary for patient comfort and to allow a thorough examination. Most emergency departments use a special device that looks like a very large contact lens with an irrigation port (Morgan lens) to irrigate the eye. With a chemical burn, the eye is irrigated for 30 minutes, allowed to equilibrate for 10 minutes, and then checked for pH[4]. Irrigation might need to be continued. Additional treatment may involve the use of topical steroids and antibiotics.

Ingestion

The amount of damage to the mouth and esophagus is dependent upon the amount and concentration of the ingested caustic material. Seeking medical help is advised. If the ingestion has been mild, a discharge from the hospital is usually expected. Copious ingestions may warrant an admission. Close observation over the next few days may be needed to assess for esophageal perforation and the administration of pain medications.

While in the emergency room, the administration of IV steroids (to decrease subsequent inflammation from the insult) and IV antacids may be administered. Although acids INITIALLY neutralize alkali, subsequent exposure of acids to damaged tissues will result in more damage. The use of antacids such as Famotidine or Pepcid may be advocated for the subsequent five to seven days.

Although there is pain, the use of NSAIDs such as Ibuprofen (i.e. Motrin, Advil), Naproxen (Naprosyn), Diclofenac (Voltaren) and Aspirin should be avoided. Tylenol appears to be a preferred alternative. Another way to reduce the discomfort of swallowing is the use of sore throat lozenges that contain benzocaine.

Inhalation

Depending on the severity, inhalation of caustic materials may require intubation and mechanical ventilation in an Intensive Care Unit. Severe damage may be very difficult to treat and can result in death.

Prevention

Is the best but not always attainable solution. If in doubt, bailout. Don't swallow or inhale. Close your mouthpiece when not in use. Check your unit for leaks, etc.

Wishing everybody safe diving!

Claudia L. Roussos MD
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[1] **chemical pneumonitis** is inflammation of the lung caused by aspirating or inhaling irritants. It is sometimes called a "chemical pneumonia", though it is not infectious.

[2] **Necrosis** is a form of cell injury that results in the premature death of cells in living tissue.

Liquefactive necrosis is a type of necrosis, which results into a liquid viscous mass.

[3] acid + base → salt + water = $\text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

[4] **pH** is a measure of the acidity or basicity of a solution. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic or alkaline.