EM CASE OF THE WEEK.

BROWARD HEALTH MEDICAL CENTER
DEPARTMENT OF EMERGENCY MEDICINE

BROWARD HEALTH
Care Warriors

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August 2016 | Vol 3 | Issue 3

Submersion Injury

A couple of unsupervised teenage kids were swimming in the ocean when a large wave came and dragged one of the kids under. After failing to surface, he was soon found and dragged to shore by one of his friends. He was apneic and CPR was immediately started. Once the paramedics arrived, he was noted to have shallow respirations and a weak but palpable pulse. His GCS score was 7. The boy was intubated and transported to the emergency department (ED). In the ED, he had a blood pressure of 100/70 mm Hg, a pulse of 60 bpm, temperature of 35.6°C (96.1°F), GCS score of 6, and an O_2 saturation of 92% on 100% FiO_2. With regard to submersion events, which of the following statements is true?

A. The Heimlich maneuver is recommended to help expel liquid from the lungs.

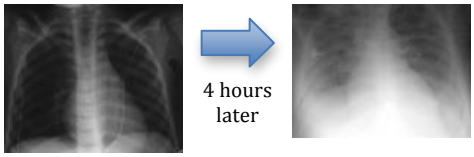
B. Neurological deficits on initial exam is a sign of poor prognosis.

C. Antibiotics can benefit those who have submersion injuries if they were in contaminated waters

D. Normal chest Xray on initial examination rules out any pulmonary insults

http://www.villages-news.com/water-safety/

- **Drowning is the 4th most common cause of accidental death in the U.S.**
- **Drowning: when death is immediate after a submersion**
- **Quick initiation of basic life support and CPR is key to improve survival**
- **Education in water safety for the community is the most important preventive method to decrease the incidence of these types of injuries**



EM Case of the Week is a weekly "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.

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The correct answer is C. Antibiotics may benefit those who have been submerged in infested or stagnant water and for those who may have any signs of infection.

Choice A: The Heimlich Maneuver is not recommended as the risk for aspiration of fluid is greater than any benefit derived and can make intubation very difficult. Choice B is not correct because even if the patient presents with some sort of neurologic deficit at the time of evaluation, it does not rule out full brain recovery post-treatment. For choice D, an initial normal chest x-ray does not rule out pulmonary problems as the findings may worsen and become apparent over time.

Discussion

Drowning is an important public health concern and a true emergency as it is the 4th leading cause of accidental death in the United States and causes over 500,000 deaths worldwide. This is especially true in places where water is easily accessible with pools and beaches, like Florida. It needs to be managed properly with community prevention and water education is key. Submersion injuries can lead to hypoxia and tissue ischemia. The highest incidence of drowning occurs in the Southern states among African-American males <5 years old from lower socioeconomic backgrounds. Do not forget to consider child abuse, as this accounts for as much as 7% of these types of injuries. Risk factors include alcohol or drug intoxication as well as pre-existing medical conditions, such as seizures and long QT syndrome. Among factors to consider is suicide or homicide. It is important to note the type of water to determine freshwater vs. saltwater (electrolyte disturbances) or natural vs. manmade (infections). There is a much higher occurrence of drowning in warm, freshwater areas like swimming pools than in saltwater areas.

Table 2. Prognostic Factors in Drowning Victims[5,6,52-57]

Poor Prognostic Indicators
• Submersion > 5 minutes
• No resuscitation for > 10 minutes
• Fixed and dilated pupils
• GCS < 5 (comatose)
• pH < 7.1
Good Prognostic Indicators
• Age < 14
• CPR in the field
• CPR < 25 min
• Detectable pulse on arrival
• T Core < 35°C (mixed results; some studies support this, some show no effect)

Pathophysiology

Drowning does not usually happen as many picture it, with the victim flailing around in the water. It typically happens silently and without warning. Initially, patients will hold their breaths until they become hypoxic and then they panic, accidently swallowing water. Aspiration of 1-3 mL/kg of water is enough to dilute surfactant leading to pulmonary edema, respiratory and metabolic acidosis and acute respiratory distress syndrome.

"Dry" drowning is without the aspiration of water, and is seen in 20% of all drowning cases secondary to laryngospasm as the pathological cause. Freshwater vs. Saltwater submersion electrolyte disturbances:

- Freshwater drowning→ hemolysis and hyponatremia.
- Saltwater drowning→ hypernatremia and hyperkalemia

Cold Water (<20°C) submersion has been thought to be more beneficial than warm water submersion, as the body becomes hypothermic and initiates the diving reflex. Hypothermia is thought to be protective to the brain by placing the body in a hypometabolic state in order to conserve O_2 and glucose. However, it can cause other problems like dysrhythmias and altered mental status and is, in fact, a very poor prognostic factor. It is important to note that hypothermia can also occur in warm water drowning. A classic EKG finding for hypothermia is the Osborne "J" waves as a positive deflection at the J point. The diving reflex is seen mostly in infants <6 months old and occurs when blood is shunted away from peripheral tissues to the vital organs including the brain and heart.

Management

ED management of a patient with drowning is shown in the algorithm below. To summarize, the initial management is first and foremost to stabilize the ABC's, correct hypoxemia and rapidly provide basic life support. Next, one can establish a GCS score to get an idea if you are going to admit or discharge the patient later. Of note, the Heimlich Maneuver to expel liquid is no longer advised due to aspiration risks. ED workup includes basic labs (CBC, glucose, electrolytes, BUN/creatinine), ABG's (to assess metabolic acidosis and O_2 saturation) and a chest x-ray (normal or may show pulmonary edema or infiltrates). ECG must be ordered to rule out any dysrhythmias. On physical exam, lungs may be clear, but can deteriorate quickly and later have abnormal breath sounds, such as rhonchi. The ED physician must also be aware of underlying problems such as intoxication, seizures or hypoglycemia as a root cause. Cervical spine collars should be placed in cases of suspected head and neck injury (e.g. a diving accident). For the hypothermic patient, warm IV normal saline and a bear-hugger should be considered once wet clothes are removed. CPR should continue for hypothermic patients until they are at least >32°C. Antibiotics may be given to victims if submerged in infected or stagnant waters, although this is not supported by the literature and is more of a judgment call.

For a list of educational lectures, grand rounds, workshops, and didactics please visit ***BrowardER.com*** and **click** on the ***"Conference"*** **link**.

All are welcome to attend!

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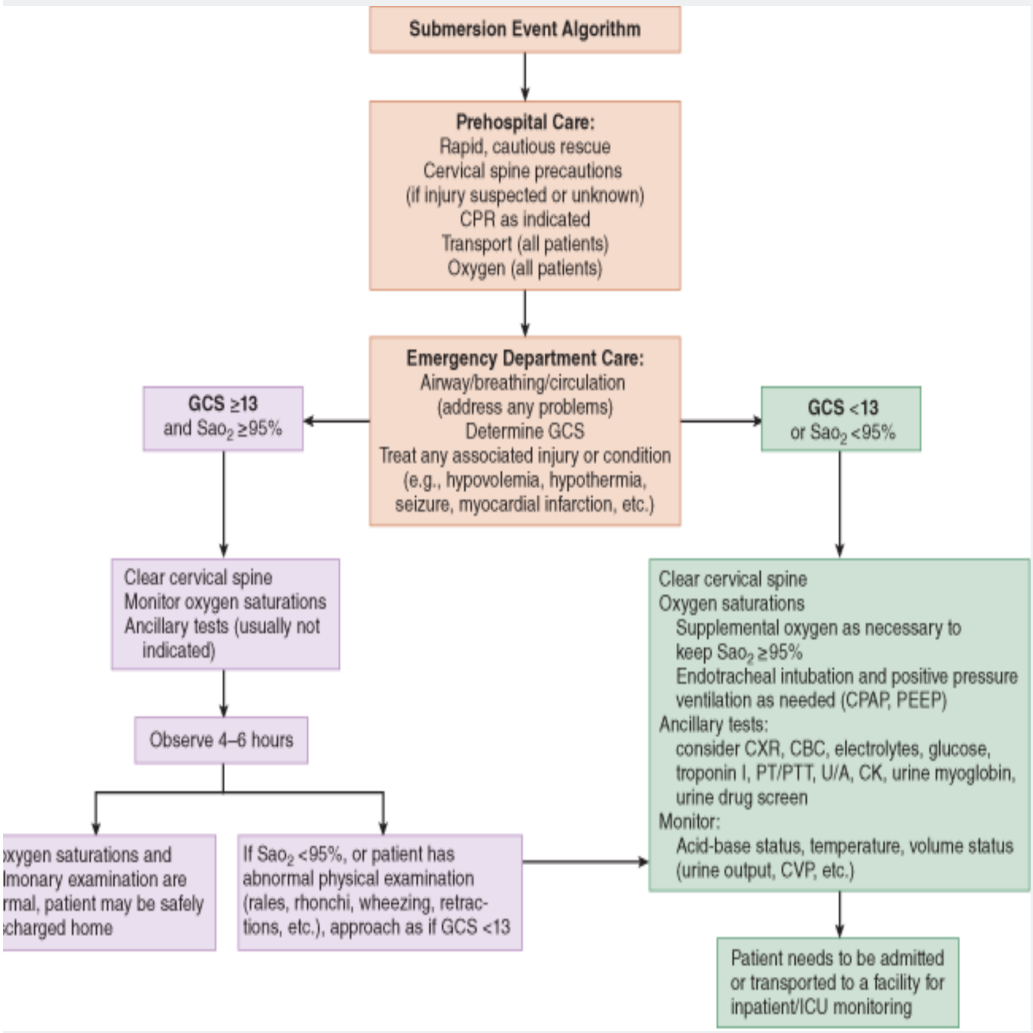

Studies show IV normal saline and ringer's lactate is better than glucose resuscitation as the increase in glucose could worsen neurological symptoms. Brain resuscitation methods, such as mannitol infusion, have shown no mortality benefit. The prognosis ultimately depends on the extent of lung and CNS damage. After observation of the patient for 4-6 hours, the patient can be safely discharged as long as the GCS is ≥ 13 and oxygen saturation is ≥ 95%. Patients should be admitted if they still need oxygen after 4-6 hours, or have been unconscious, hypoxic, or are still symptomatic. Those with a GCS ≤ 13 should be given O_2 and the indications to intubate are if PaO_2 is < 60 mm Hg or <80 mm Hg in children despite oxygen supplementation.

Take Home Points

- The most important initial treatment in drowning cases is ventilation with rapid resuscitation efforts
- Be aware of precipitating factors such as alcohol, seizures and hypoglycemia, as well as cervical spine and head injuries
- The most common complications are pulmonary and CNS dysfunction and dysrhythmias
- Patients are at risk of hypothermia even in warm water submersions
- Hypothermic victims of cold water submersions with cardiac arrest should be resuscitated until core temperature is >32°C
- The patient needs to be observed for 4-6 hours and prognosis ultimately depends onn the extent of pulmonary and CNS injury.

ABOUT THE AUTHOR

This month's case was written by Siddarth Goyal. Siddarth is a 4th year medical student from NSU-COM. He did his emergency medicine rotation at BHMC in August 2016.

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