

EM CASE OF THE WEEK.

BROWARD HEALTH MEDICAL CENTER
DEPARTMENT OF EMERGENCY MEDICINE



Care Warriors

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Submersion Injuries

A 3-year old male with no past medical history presents to the ED via EMS after being found submerged in his family's backyard pool. Per the caregiver, she went to prepare lunch and returned to the backyard to find her grandson in the pool after being gone for a maximum of 5 minutes. She retrieved the apneic kid from the pool, called 911 and started CPR. Once paramedics arrived, he was noted to be apneic with a weak but palpable pulse and a GCS score of 6. The boy was intubated and transported to the emergency department. In the ED, he had a pulse of 65 bpm, BP 95/60 mmHg, temperature 35.8°C (96.4°F), GCS score of 6T and SpO₂ 95% on 100% FiO₂ via BVM. Which of the following statements is true in regards to submersion events?

- A. A submersion event occurring in cold water (<20°C) is a good prognostic indicator.
- B. Abdominal thrusts should be used to remove fluid from a distended abdomen.
- C. Cervical spine immobilization is indicated for all victims found in shallow water.
- D. Distinguishing if the submersion occurred in fresh water or salt water is not clinically important.



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Lifeguards demonstrating early BLS response prior to EMS arrival.

- Drowning events should be classified as nonfatal and fatal.
 - The use of terms, such as near, wet, dry, silent, passive, active and secondary, should be avoided.
 - Hypoxic injury is the result of any drowning event.
- In children, drowning is second only to motor vehicle injuries as a leading cause of accidental death in the US.
- Water Safety education in the community is the most important preventative measure.
- Quick recognition and initiation of BLS measures is crucial for survival

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 D. Distinguishing if the submersion occurred in fresh water or salt water is not clinically important. It was previously thought that the hypertonicity of salt water caused fluid shift from the bloodstream to the pulmonary interstitium and alveoli, causing pulmonary edema and hypertonic serum and that fresh water created the opposite effect, shifting water from the lungs into the intravascular compartment, causing serum dilution. Studies have indicated that one must aspirate greater than 11 ml/kg body weight before blood volume changes occur and more than 33 ml/kg before changes in electrolytes occur. Because it is unlikely for nonfatal drowning victims to aspirate more than 3-4 ml/kg, this distinction is no longer considered important.

Choice A: While cold water was traditionally thought to benefit drowning victims by decreasing metabolic demands and activating the diving reflex, a case control study published in 2014 analyzing 1094 open water drowning victims failed to prove association between water temperature and survival with good neurologic outcome.

Choice B: Abdominal thrusts should not be utilized in order to decompress the abdomen as this poses aspiration risks. The first priority is securing the airway by suctioning any fluid or vomitus in the oropharynx and then placing an ET tube if clinically indicated. Following ET tube placement, an orogastric tube may be placed to reduce abdominal distention.

Choice C: Cervical spine immobilization is only indicated for patients of suspected trauma, including bystander history of patient diving into water, injury during water sport, etc. In a cohort of 2244 submersion victims, only 11 sustained cervical spine injuries and each had clear evidence of injury and mechanism suggestive of spinal trauma. Routine cervical spine immobilization can interfere with essential airway management and is thus not recommended.

Discussion

Drowning is one of the leading causes of childhood morbidity and mortality in the world. In the US, it is second to motor vehicle injuries as a leading cause of death from unintentional injury. Between 2005-2009 an average of 3,880 people per year were victims of fatal

drowning with an estimated 5,789 people per year treated in EDs for nonfatal drowning. The age distribution is bimodal with the first peak occurring in children <5 years of age and the second peak occurring mostly in males between 15-25 years of age.

Risk Factors

- Inadequate adult supervision
- Inability to swim or overestimation of swimming abilities
- Risk-taking behavior
- Use of alcohol and illicit drugs (>50% adult drowning deaths linked to alcohol consumption)
- Hypothermia (rapid exhaustion, cardiac arrhythmias)
- Concomitant trauma (water sports, diving), stroke, MI
- Seizure disorder or neuro-developmental/behavioral disorders
- Undetected primary cardiac arrhythmia (congenital long QT type 1, familial polymorphic VT)
- Hyperventilation prior to shallow dive (reduces PaCO₂; with continual depletion of PaO₂ during the dive and failure of PaCO₂ to trigger urge to breathe, cerebral hypoxia, seizures and LOC occur.

Pathophysiology

Both fatal and nonfatal drowning events start with a phase of panic, struggle by the victim to stay above water, loss of normal breathing pattern, breath holding, air hunger. The increase in air hunger triggers reflex inspiratory efforts, resultant hypoxemia via aspiration or reflex laryngospasm. This hypoxemia ultimately produces tissue hypoxia, affecting all tissues and organs in the body, with the major component of morbidity and mortality being cerebral hypoxemia.

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!

Warriors

Poor Prognostic Factors

- Duration of submersion >5 minutes (most critical)
- Time to effective BLS >10 minutes
- Resuscitation duration >25 minutes
- Age >14 years of age
- GCS <5
- Persistent apnea and requirement of CPR in ED
- Arterial Blood pH <7.1 upon ED arrival

Treatment

The initial step in management of any submersion victim is to safely extract the victim from the water, stabilize ABCs, and provide rapid BLS measures, focusing on ventilation. If suspected cervical spine injury, immobilization should occur. Prior to ED arrival, ACLS protocols should be followed with GCS scoring, cardiac monitoring, IV access and advanced airway established if indicated, maintaining SpO₂ saturations ≥95%.

Upon ED arrival, basic labs (CBC, CMP), ABG and CXR should be obtained. 12 lead ECG must assess for any dysrhythmia. For hypothermic patients, remove wet clothing, apply warm blankets, and utilize warm IV NS. If CPR is in progress, it should be continued until core body temperature is >32°C. A detailed history should be obtained from any bystander or EMS personnel to assess for any special considerations, such as intoxication, seizures, hypoglycemic event, and trauma.

If the patient arrives and remains asymptomatic with normal vital signs, labs and imaging studies, re-evaluation should be completed after 6-8 hours of observation; the patient may be discharged at that time if status is unchanged.

Take Home Points

- The most important step to reduce the impact of drowning injury is prevention through community education.
- The most important factors for good outcomes is submersion time less than 5 minutes and early initiation of CPR at the scene.
- Pulmonary, central nervous system and dysrhythmia complications are the most common insults of drowning
- Hypothermic victims must be warmed with ACLS protocols extended until core body temperature is >32°C.
- Patients should be closely monitored in the ED for 6-8 hours and may only be discharged once repeat imaging studies (CXR) and labs are stable or unchanged.



ABOUT THE AUTHOR

This month's case was written by Zachary Smith. Zac is a 4th year medical student from NSU-COM. He did his emergency medicine rotation at BHMC in December 2017. He plans on pursuing a career in Pediatrics after graduation.

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