Drowning

Quick Guide:

Patients should be activated per their physiology and suspected injuries, which will most often be a full trauma given that the majority of suspected injuries include airway issues, level of consciousness/brain injury, and/or spinal cord injuries.

Trauma should be the admitting service to the appropriate level of care. If ICU admission is warranted, the appropriate critical care team should also be consulted (i.e Critical Care Surgery (CCS) for patients >12 yrs of age and Pediatric Critical Care Medicine (PCCM) for patients ≤12 yrs of age).

Patients who have an event where they are submerged in water but return to baseline at the scene without concern for traumatic injuries do **not meet these criteria and do **not** need a trauma activation for the submersion event. They may be safely evaluated in the ER and observed by medical admitting services (most often pediatrics).

Terms

Drowning is the process of experiencing respiratory impairment from submersion or immersion in liquid.

There are no medically accepted conditions known as “near-drowning,” “dry drowning,” “secondary drowning” or delayed drowning wherein a person was submerged in the water at some point, had no immediate breathing difficulty and later developed delayed onset of respiratory symptoms after a period of being asymptomatic [3].

Epidemiology

Drowning is the leading cause of death for children ages 1-4, and the second leading cause of unintentional injury-related death for children 5-14 (second only to MVCs) [1]. There is another peak among children and young adults aged 15-30, most often due to recreational swimming in natural bodies of water [2]. Other risk factors include alcohol consumption, hypothermia, traumatic injury leading to unconsciousness, neurodevelopmental conditions, and seizure disorders.

Pathophysiology of Injuries

Airway:

Panic results in disruption of normal breathing patterns, subsequent aspiration of fluid leads to laryngospasm and hypoxemia.

Pulmonary:

There is no difference between salt and fresh water- both result in hypoxemia and surfactant destruction, predisposing patients to noncardiogenic pulmonary edema and acute respiratory distress syndrome (ARDS).

Cardiac:

Arrhythmias may occur secondary to hypoxemia and hypothermia.

Neurologic:

Cerebral edema and elevated intracranial pressure develop as consequences of cerebral hypoxia, which is the major contributor to morbidity and mortality.

Later findings:

Hypoxia and hypoperfusion can trigger systemic inflammatory response, causing isolated cardiac, renal, or hepatic dysfunction, sepsis, or multiorgan failure. Rarely, patients with normal initial chest x-rays (similar to pulmonary contusions) may develop fulminant pulmonary edema within 12 hours, potentially reflecting delayed ARDS, neurogenic edema, or airway hyperreactivity.

Death from drowning primarily results from hypoxemia caused by water aspiration, which disrupts alveolar gas exchange, destroys surfactant, and produces noncardiogenic pulmonary edema. If rescue does not occur, hypoxia rapidly leads to loss of consciousness, apnea, and hypoxic cardiac arrest, usually presenting with bradycardia or pulseless electrical activity. Later deaths mainly arise from neurologic injury due to prolonged cerebral hypoxia [5].

History & Physical Examination

-focus the history on duration of submersion, length of extraction/rescue time, whether pulses were lost and/or if CPR was required. The likelihood of diving related injuries associated with the entry into the water are also important.

-additional questions regarding nonaccidental trauma can be added depending on the individual patient’s circumstances.

-obtain labs for toxicology, ethanol, metabolic derangements (most commonly lactic acidosis)

-Physical examination for signs of traumatic injuries as per standard ATLS protocol

Early Management/Stabilization

-Patients should be activated per their physiology and suspected injuries, which will most often be a full trauma

-Evaluate ABCs as always (primary and secondary survey per ATLS protocol)

-Immobilization of the spine is recommended for patients who sustained a dive or present with an unknown history

- Noninvasive positive pressure ventilation or endotracheal intubation may be required to maintain oxygen saturation

-Hypothermia should be addressed by passive rewarming and removal of cold wet clothes

-Noncardiogenic pulmonary edema and ARDS may develop over the next 12-24 hours [6]

-Glucocorticoids, diuretics, and empiric antibiotics are **not** recommended for routine use. Antibiotic therapy should be initiated only if clinical evidence of infection emerges [7]

Imaging

- Chest x-ray

- Non-contrast CT Head

- CT C-spine

- CTA neck and Head

- Can consider additional CTs (i.e. Trauma “pan scan”) if patient is unconscious, physical exams warrants, or history is concerning for additional injuries or if history is uncertain

Disposition

Trauma should be the admitting service to the appropriate level of care:

-Admit critically ill patients to the ICU with either CCS or PCCM consultation

-Admit patients without ICU needs to the Trauma service

-Patients with mild or no symptoms may be observed in the ER for 4-8 hours.

-ECMO may be considered as salvage therapy for refractory hypoxemia or severe hypothermia. These patients would be admitted to the CVICU under CCA for ECMO therapy, with transfer back to trauma floor or ICU as appropriate when weaned from ECMO.

Author and last update

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