

Fast Five Quiz: Drowning

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Drowning remains a significant worldwide public health concern, [ranking as the third leading cause of death from unintentional injury](#). It also remains a major cause of disability in those who survive. The current consensus definition states that drowning is a process that results in primary respiratory impairment from submersion in a liquid medium. The terms wet drowning, dry drowning, active or passive drowning, near-drowning, secondary drowning, and silent drowning may be noted in historical references; however, they have been abandoned in favor of the general term—drowning.

Swimming is a popular activity in the summer months. Do you know the risk factors for drowning and key aspects to consider? Make sure you're prepared by taking this quick quiz.

Which of the following is most accurate regarding risk factors for drowning?

Your Peers Chose:

Females are at an increased risk of drowning compared with males, with nearly twice the mortality rate 1%

The age group at highest risk of drowning is children aged 5-9 years 46%

Higher socioeconomic status and urban populations are associated with an increased risk of drowning as opposed to lower socioeconomic status and rural populations

9%

Seizure disorders, such as epilepsy, increase the risk of drowning by as much as 19-fold compared with the general population

44%

The risk of drowning in people with seizure disorders, most notably epilepsy, is raised 15- to 19-fold [compared with the general population](#). Males are also at increased risk of drowning. [The World Health Organization \(WHO\)](#) reports that males have twice the overall mortality rate of females and they are more likely to be hospitalized than females for nonfatal drowning. The WHO's Global Report on Drowning: Preventing a Leading Killer found that the highest drowning rates are seen among children aged 1-4 years, followed by children aged 5-9 years. A bimodal age distribution is noted, in that adolescents aged 15-19 years are also at increased risk.

The WHO also lists other factors associated with an increased risk of drowning, which include:

- Lower socioeconomic status, being a member of an ethnic minority, lack of higher education, and rural populations are all associated with increased risk, although this association can vary across countries.
- Infants left unsupervised or alone with another child around water are at increased risk.
- Alcohol use near or in the water increases the risk of drowning.
- Tourists unfamiliar with local water risks and features are also at increased risk.

[Read more about the risk factors for drowning.](#)

Which of the following locations is most common for drownings among children aged 1-4 years?

Your Peers Chose:

- Home swimming pools 88%
- Public swimming pools 4%
- Rivers 6%
- Oceans 2%

According to the CDC, most children aged 1-4 years drown in home swimming pools. The percentage of drownings in natural water settings, including lakes, rivers, and oceans, increases with age. More than half of fatal and nonfatal drownings among those aged 15 years and older occurred in natural water settings. Drownings among infants younger than 1 year mostly occur in bathtubs, toilets, or buckets.

[Read more about drowning episodes by age group.](#)

Which of the following is most accurate regarding complications associated with drowning?

Your Peers Chose:

Pneumonia is a common complication of submersion injury and is most commonly associated with near-drowning in colder water and salt water

27%

Aspiration of 5-6 mL/kg of fluid while drowning is required for significant impairment of gas exchange 24%

Although cardiovascular effects may be severe in those who nearly drown, they are usually transient, unlike severe central nervous system (CNS) injuries

33%

The rapid development of core hypothermia, especially in young children, is associated with more severe neurologic sequelae than slower development of core hypothermia

16%

Drowning may result in an acute asphyxial cardiac arrest, which emanates from hypoxemia that precedes the development of ischemia. This scenario results from initial cessation of gas exchange followed by worsening hypoxia and eventual cardiac arrest. Myocardial dysfunction may result from ventricular dysrhythmias, pulseless electrical activity, and asystole due to hypoxemia, hypothermia, acidosis, or less commonly, electrolyte abnormalities. Pulmonary hypertension may result from the release of pulmonary inflammatory mediators, increasing right ventricular afterload and thus decreasing pulmonary perfusion and left ventricular preload. However, although cardiovascular effects may be severe, they are usually transient, unlike severe CNS injury.

Pneumonia is a rare consequence of submersion injury and is more common with submersion in stagnant warm and fresh water. Uncommon pathogens, including *Aeromonas*, *Burkholderia*, and *Pseudallescheria*, cause a disproportionate percentage of cases of pneumonia. Pneumonia is uncommon early in the course of treatment of submersion injuries, so the use of prophylactic antimicrobial therapy has not proven to be of any benefit.

The target organ of submersion injury is the lung. Aspiration of as little as 1-3 mL/kg of fluid leads to significantly impaired gas exchange. Injury to other systems is largely secondary to hypoxia and ischemic acidosis.

Primary CNS injury is initially associated with tissue hypoxia and ischemia. If the period of hypoxia and ischemia is brief or if the person is a very young child who rapidly develops core hypothermia, primary injury may be limited, and the patient may recover with minimal neurologic sequelae, even after more prolonged immersion. In contrast, drowning that is associated with prolonged hypoxia or ischemia is likely to lead to both significant primary injury and secondary

injury, especially in older patients who cannot rapidly achieve core hypothermia.

[Read more about complications of near-drowning.](#)

Which of the following is most accurate regarding the physical examination and workup of patients with a near-fatal episode of drowning?

Your Peers Chose:

Patients who have slight dyspnea upon physical examination after near-fatal drowning are considered asymptomatic

13%

Acute renal impairment is common in drowning, although it is usually mild (serum creatinine level < 0.3 mmol/L or 3.4 mg/dL)

25%

Metabolic alkalosis is a common finding after near-fatal drowning 43%

Pulmonary artery catheters are preferred above arterial and central venous catheters in most patients after a near-drowning episode

19%

Patients are especially likely to be asymptomatic if they experience brief, witnessed submersions with immediate resuscitation.

Patients who are symptomatic may exhibit:

- Altered vital signs (eg, hypothermia, tachycardia or bradycardia)
- Anxious appearance
- Tachypnea, dyspnea, or hypoxia: If dyspnea occurs, no matter how slight, the patient is considered symptomatic
- Metabolic acidosis (may exist in asymptomatic patients as well)
- Altered level of consciousness, neurologic deficit
- Cough
- Wheezing
- Hypothermia
- Vomiting, diarrhea, or both

Management of hypoxemia is the key to the management of patients who have a drowning episode. A surprising degree of hypoxia may be present in a relatively asymptomatic patient. Continuous pulse oximetry should be used, and a rapid glucose determination, complete blood cell count, electrolyte levels, lactate level, and coagulation profile should be obtained, if indicated. Collect urine for urinalysis, if indicated. Measure liver enzyme levels, especially aspartate aminotransferase and alanine aminotransferase levels. Consider a blood alcohol level and urine toxicology screen to look for the use of drugs. Cardiac troponin I testing may be useful as a marker to predict children who have an elevated risk of not surviving to hospital discharge.

If initial test results show an elevated serum creatinine level, marked metabolic acidosis, abnormal urinalysis, or significant lymphocytosis, serial estimations of serum creatinine level should be performed. Acute renal impairment is known to occur frequently in drowning, and although usually mild (serum creatinine level < 0.3 mmol/L or 3.4 mg/dL), severe renal impairment requiring dialysis may occur.

Arterial and central venous catheters may be useful in monitoring cardiac output and related hemodynamic parameters. Pulmonary artery catheters are less frequently used, yet may prove useful in patients with unstable cardiovascular status or in those who require multiple inotropic and vasoactive medication requirements.

[Read more about the workup of drowning.](#)

Which of the following is most accurate regarding the treatment of patients who have experienced nonfatal drowning?

Your Peers Chose:

Early use of continuous positive airway pressure (CPAP)/bilevel positive airway pressure (BiPAP) in a patient who is awake, cooperative, and less hypoxic is warranted if the hypoxia or dyspnea persists despite the patient receiving 100% oxygen after a drowning episode

45%

Patients who remain comatose after a drowning episode that occurred in cold water should be warmed to a minimum core temperature of 96.8°F (36°C)

37%

Surfactant therapy is routinely recommended in all patients after a drowning episode unless severe hypoxemic respiratory failure is present

12%

Extracorporeal membrane oxygenation (ECMO) is contraindicated in patients with persistent hypothermia from cold-water drowning

6%

The most critical role in management is prompt correction of hypoxemia and acidosis. The degree of hypoxemia is often underrecognized. Patients should receive 100% oxygen and be monitored closely via pulse oximetry, blood gas analysis, or both. Consider intubation and positive end-expiratory pressure (PEEP) with mechanical ventilation support in any patient with poor respiratory effort, altered sensorium, severe hypoxemia, severe acidosis, or significant respiratory distress.

Supplemental oxygen at a fraction of inspired oxygen of 100% should be administered as soon as it is available. The degree of hypoxemia of a patient may be difficult to determine on clinical observation. If available, it is optimal to use of continuous noninvasive pulse oximetry. If the patient remains dyspneic when receiving 100% oxygen or has a low oxygen saturation, use CPAP if it is available. If it is not available, consider early intubation with appropriate use of PEEP. Early use of intubation and PEEP, or CPAP/BiPAP in the awake, cooperative, and less hypoxic patient, is warranted if hypoxia or dyspnea persists despite the patient receiving 100% oxygen.

Ascertaining whether the drowning occurred in warm or cold water is essential. This depends on the temperature of the water and not the temperature of the patient. Maintaining mild hypothermia (core temperature, 89.6°F-93.2°F [32°C-34°C]) may be indicated for 12-24 hours in patients who remain comatose after a drowning episode.

ECMO may be considered in patients after a drowning episode in these circumstances:

- Respiratory compromise resulting from lack of response to conventional mechanical ventilation or high-frequency ventilation
- A reasonable probability of the patient recovering neurologic function
- Persistent hypothermia from cold-water drowning

Efficacy of surfactant therapy [has been reported](#); however, the routine administration of surfactant is not supported by present evidence. Use should be reserved for those with severe hypoxemic respiratory failure.

[Read more about the treatment of drowning.](#)

This Fast Five Quiz was excerpted and adapted from the Medscape Drugs & Diseases article [Drowning](#).

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