

# Drowning (Treatment of Near Drowning)

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## Definitions

- Drowning is a process resulting in primary respiratory impairment from submersion or immersion in a liquid medium (1).
- Near drowning implies recovery (even if temporary) from drowning.
- Immersion syndrome refers to drowning as a result of a cardiac event such as a vagal response.
- Hyperventilation drowning is seen secondary to intentional hyperventilation to increase the time spent underwater.
- Wet drowning implies water or other liquid debris (such as vomitus) is aspirated into the lungs. This is present in about 90% or more of all drowning incidents.
- Dry drowning is secondary to laryngospasm persisting beyond the time the victim loses consciousness and stops breathing. This type of drowning is uncommon (2).

## Epidemiology

- In the United States, drowning is now the second leading cause of unintentional injury death among children aged 1 to 19 years, accounting for about 850 deaths per year (2008-2010) (3).
- Although 50% of events occur in swimming pools, natural bodies of water such as lakes and streams, bathtubs, and storm drains contribute heavily to drowning accidents.
- Males are more likely to drown than females, and toddlers in the 0 - 4 year age group are more likely to drown than other age groups (2).
- Factors contributing to drowning include unattended children at water sites, alcohol or drug abuse, risky behavior (such as rough play), and underlying medical conditions such as seizures.
- The suction created by some older drains is sufficient to entrap victims under water (4).

- For every death due to drowning, there are 10 - 20 near-drowning episodes, and there are 2 emergency department visits for every drowning death (2).
- Ninety percent (90%) of children are within 10 yards of safety when they drown, emphasizing the tragic nature of drowning.

## Prevention

Prevention of drowning is an important part of pediatric anticipatory guidance and well-child care (5). The American Academy of Pediatrics has recently revised its recommendations on prevention to accept swimming lessons as an important part of drowning prevention. Prevention includes the following major components (5) :

- Small children should always be supervised by a responsible adult when the children are around any body of water.
- Pediatricians are encouraged to identify families at risk for drowning to include those with home and residential pools.
- A four-sided fence should be installed with vertical bars no more than 4 inches apart. The house does not count as a barrier. The gate should be self-latching and be at least 54 inches from the ground.
- Pool alarms and covers may be installed, although data are lacking on their effectiveness.
- Body and hair entrapment should be prevented by installing modern drain covers.
- All children over 4 years of age should be taught to swim, and children 1-4 years of age may benefit from swimming lessons.
- Parents, caregivers, and pool owners should learn CPR.
- Air-filled swimming aids should not replace life jackets.
- Children should wear life jackets when riding in watercraft.
- Ascertain the depth when jumping or diving into water.
- Swim in sites with lifeguards.
- Exercise caution during cold seasons when ice skating or walking on ice.
- Exercise particular caution for children with seizures, even when bathing.
- Discourage any drug or alcohol use while swimming or on watercraft.

## Treatment

Treatment of a near-drowning victim should begin as soon as possible at the scene after the incident and continue until reaching a pediatric care center. The most important principles of treatment are:

- Begin resuscitation at the scene.
  - Bystander resuscitation is the most important aspect of a successful outcome, and survival is dependent on immediate resuscitation (6).
  - Immediate resuscitation should be initiated even though near-drowning victims often appear bluish, mottled, pale, and without a palpable pulse.
  - Cervical and head injuries may accompany shallow diving accidents, but trauma is unusual without a clear history (7).
  - Cardiopulmonary resuscitation should not be delayed or altered in most near-drowning episodes.
  - The abdominal thrust is not indicated.
  - Ventricular defibrillation is not indicated.
  - In cases of cold weather drowning, prevention of further heat loss is important, but rewarming should not be attempted outside a critical care pediatric facility.
- Hypoxia is the immediate threat in near drowning.

- Free flow oxygen should be provided when available.
- Standard cardiopulmonary resuscitation to include the use of ventilation, oxygen, and chest compressions should be continued until the patient arrives at a pediatric facility.
- No prognostic parameters have come to a clinically relevant conclusion to withhold or stop resuscitation in the emergency department.
- If a patient is comatose, even if there is a palpable pulse, the child should be taken to a pediatric level I trauma center rather than a community emergency department.
- In the emergency department (2)
  - Establish ventilation either by free flow nasal cannula or CPAP if the patient is breathing spontaneously or by mechanical ventilation if the victim cannot maintain its own respiration.
  - Ventilation/perfusion mismatch is the main initial concern.
  - Pulmonary edema is common and continuous positive airway pressure is often beneficial.
  - Initially, patients may appear stable, but pneumonia due to aspiration and atelectasis due to surfactant inactivation or depletion may result in deterioration as long as 12 hours after the incident.
  - Patients may be discharged, however, if they are breathing normally and normoxic on room air after 6-8 hours (8).
  - Establish IV access and evaluate electrolytes; occasionally fresh water near drowning can result in hyponatremia.
  - Most near-drowning victims suffer from intravascular volume depletion and require fluid resuscitation.
  - Salt-water drowning results in more fluid being drawn into the alveolar space resulting in more severe hypovolemia.
  - Most comatose near-drowning victims demonstrate acidosis, which should be corrected with bicarbonate.
  - Hypothermia is common and rewarming with cardiopulmonary bypass (ECMO) is often necessary; thus, hypothermic patients should be referred to a pediatric center with ECMO capability, if possible (9).
  - Cardiac dysrhythmias are usually due to hypoxemia and treatment of the underlying cause will usually resolve the cardiac arrhythmias (2).
  - Continuous central nervous system monitoring is indicated in cases of severe near-drowning episodes (10, 7).
  - Avoid hyperthermia.

## Outcome

- Cannot be determined with good reliability until 24-48 hours after the incident
- The brain is the most vulnerable organ in near drowning.
- Neuroprotective strategies have not been shown to be helpful, but mild hypothermia in comatose individuals, after rewarming, may be of some benefit.
- The following denote a worse prognosis:
  - PRISM score >24, died, or had severe sequelae (11)
  - pH <7.0, glucose > 300, apnea, bradycardia, lactic acid level >6 mmol/l, and immersion time >10 minutes were all associated with a worse prognosis (12)
  - Warm vs. cold water submersion
- Long term adverse outcomes include seizures, cerebral palsy, and cognitive delay.
- Neuropsychological testing may reveal abnormalities despite normal imaging studies.(10).

*This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient,*

*resources available, and limitations unique to the institution or type of practice may warrant variations.*

## References

## References

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