

# **Drowning and Near-Drowning: Prevention and Treatment**

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If you do not think of drowning as a major health problem, you probably do not work in an emergency room. Drowning is the third most common cause of accidental death in the United States, causing almost 8,000 deaths each year. Worldwide about 150,000 people drown annually. Statistical reporting on near-drowning is unreliable, but experts have estimated that there may be 600 near-drowning incidents for every reported drowning death.

One reason that near-drownings are difficult to count is that the term is not easy to define exactly. The standard medical definition of near-drowning is survival, at least temporarily, after suffocation by submersion in water or other liquid. Authorities differ on whether to include loss of consciousness as a criterion. Others draw a distinction between "wet near-drowning", in which fluid is aspirated into the lungs, and "dry near-drowning."

## **Who is at Risk?**

There are two times in your life when you are at the greatest risk of drowning. The first is when you are five years old or younger. The classic scenario is the child left unattended or poorly supervised near a swimming pool or bathtub. The second peak is when you are between 15 and 25 years old. Overwhelmingly males, victims in this category tend to drown while enjoying themselves at rivers, lakes, and beaches. Alcohol or illegal drugs are often involved. More than 50% of adult drowning deaths are believed to be alcohol-related.

If you were to rank, by importance, the risk factors that contribute to drowning and near-drowning, the list would look like this:

- Inability to swim or overestimation of swimming capabilities
- Risk-taking behavior, including the use of alcohol and illicit drugs
- Inadequate adult supervision of children
- Trauma (such as a physical injury), seizures, stroke, heart attack or heart arrhythmia
- "Shallow water blackout" in which swimmers hyperventilate in order to swim longer under water. This can lead to a lack of oxygen in the brain and loss of consciousness.
- Hypothermia, or lowered body temperature. This can lead to heart arrhythmia and rapid exhaustion.

## **Salt Water vs. Fresh Water Drowning**

Medical authorities traditionally made a great distinction between salt water and fresh water drownings. The theory was that because of its high salt content, sea water in the lungs would affect the body very differently from fresh water in a variety of ways. Although this is true in theory, very few survivors of near-drowning ingest enough water to make a difference and this rarely becomes an issue in treating patients who arrive at the hospital.

In practice, water temperature and the presence of any contaminants are much more important considerations.

## **How Near-Drowning Damages the Body**

Most of the effects of near-drowning on the body fall into one of two categories. The first includes interference with or stopping of breathing and the damage this does to the lungs, heart, brain and nervous system. The second includes all of the problems brought on by altered (usually lowered) body temperature, something that happens when we spend any length of time immersed in liquid.

When taken into the lungs, both salt and fresh water have the effect of washing out surfactant, the thin coating which bathes the inside of the lungs. The loss of surfactant creates breathing problems of its own, including pulmonary edema, fluid in the lung tissue, which can in turn bring on ARDS, or acute respiratory distress syndrome. Signs and symptoms of ARDS include shortness of breath and wheezing.

When the flow of air to the lungs is obstructed, the results include hypoxia (lowered levels of oxygen in the blood) and ischemia (loss of blood flow to the extremities). These lead to immediate neurological problems, including swelling of the brain and dangerous increases in intracranial pressure. About 20% of near-drowning victims sustain neurological damage; this is the number one cause when near-drowning victims cannot be revived after rescue.

Hypoxia and heart arrhythmia brought on by lowered body temperature are the most common heart and circulatory problems seen in near-drowning victims.

Finally, electrolyte imbalances are a serious but extremely rare occurrence in near-drowning survivors. They happen in cases such as immersion in a liquid other than water, or in an exceptional environment such as the Dead Sea, whose high salt content can lead to life-threatening changes in the victim's magnesium and calcium levels.

## **First Aid at the Scene**

The first thing to remember is that hypothermia can make it very difficult to find the pulse of a near-drowning survivor. Therefore, a careful search for pulse should be done, for at least a minute, before trying to restart the heart by chest compressions. The Heimlich or other maneuvers aimed at draining water from the body are of little use; it is much more important to try to get the victim breathing immediately instead. It is also vital to begin to bring the victim's body temperature back up to normal levels, using whatever means is at hand, from blankets to heaters or hot packs.

## **Treatment at the Emergency Room**

Most near-drowning victims are hospitalized and monitored for some time. However, a recent study found that virtually all victims who develop additional symptoms do so within seven hours of immersion. Based on that and other evidence. We can say that near-drowning victims who are doing well eight hours after rescue can be safely sent home with nothing more than a follow-up call or evaluation visit.

When a near-drowning victim is first brought to the hospital, the main focus is on core rewarming. Methods available in the hospital include giving warmed fluids intravenously; introducing heated oxygen into the lungs using an endotracheal tube; and lavage, or washing out with warm fluids, of the stomach, bladder, lungs, and other internal organs and spaces. In extreme cases, doctors will try to rewarm the body by pumping the blood through an external device in order to raise its temperature quickly. If the heart and lungs do not begin to function normally after rewarming, further attempts at resuscitation are likely to be futile.

## **Prognosis: The Bad News**

ER studies have shown that near-drowning victims are likely to have a poor outcome if:

- they have spent more than 10 minutes under water
- it has taken more than ten minutes to give them basic life support
- their core body temperature has fallen below 91.4 degrees Fahrenheit
- they have a score on the Glasgow coma scale of 5 or lower they are younger than 3
- they have persistent apnea (arrested breathing) or need frequent CPR in the ER
- their arterial blood pH is less than 7.1
- the water in which they were immersed is warmer than 50 degrees Fahrenheit

This last item needs some explanation. Despite the dangers of hypothermia, cold water can sometimes actually lessen some of the other, more dangerous effects of near-drowning. It does this by (a) preventing or delaying the effects of hypoxia and (b) setting off the diving reflex, a primitive bodily reflex, (particularly common in children), that shunts blood from the extremities to the vital organs.

## **Further Treatment in the Hospital**

In most cases of near-drowning, the victim's outcome has already been largely determined by what has happened before and during their time in the ER. The primary goal of treatment in the ICU, therefore, is to prevent any further damage to the neurological system from ongoing circulatory problems, lack of oxygen (hypoxia), fluid and electrolyte imbalances, higher acidity (lowered pH) of bodily fluids and seizures.

A 1978 study reported that giving barbiturate drugs and inducing controlled hypothermia lessened neurological damage in unconscious, near-drowning victims. Subsequent studies, however, have not backed this up. A risk in using hypothermia as a therapy is the possibility of internal infection (sepsis), probably caused by the fact that cold suppresses the body's immune system.

The main treatments for the neurological effects of near-drowning are:

- Mild hyperventilation. Excessive hyperventilation should be avoided because it may cause reduced blood flow to the brain.
- Aggressive control of seizure activity. Seizures and hypoxia are a dangerous combination because cerebral oxygen consumption is increased during a seizure. Phenytoin is the drug of choice because it does not interfere with neurological examination.
- Elevation of the head of the bed, as long as there is no suspicion of neck injury.
- Muscle relaxants, but only if required to treat respiratory failure. These drugs can be risky because they mask symptoms of neurological damage.
- Maintenance of proper blood sugar levels.
- Maintenance of normal body temperature.

## **Survival**

About 75% of near-drowning victims who receive medical treatment survive. Of these, approximately 6% will be left with long-term neurological problems. Unfortunately, as our techniques for restoring breathing continue to improve, this percentage is actually going up. This has created a growing moral and practical dilemma for families and friends of victims, as well as for doctors and other medical professionals, who have to make painful decisions about whether to undertake or to continue resuscitation measures.

## **Prevention**

The best solution for the problem of drowning and near-drowning is prevention. The overwhelming majority of cases are, sadly, easily preventable. For instance, effective fencing around swimming pools that keeps out all children under the age of four would lower the number of pool drownings by 80%. There is no question that similar reductions could be achieved by education programs stressing the importance of adult supervision of children near water, the wearing of life jackets in boats, and -- above all -- avoiding drugs and drinking while swimming or boating.