

Hypothermia

Whether you're diving the Antarctic, the chilly U.S. Pacific Northwest or your local lake or quarry, you make temperature one of the components of your dive plan: What's the ambient temperature topside? What's the water temperature like? Are there any thermoclines? How deep will I dive and for how long? What exposure protection do I need? Will a quarter-inch wetsuit be enough?

In essence, you're asking yourself: How cold am I going to get on this dive? You're also answering that question with your dive planning. Hypothermia can affect even tropical dives – if you're wearing just a swimsuit or diveskin and you remain immersed for a long time, that is. So, what is hypothermia, exactly? How do you prevent it? How do you deal with it once you're chilled? Read on.

Taken from the 2006 DAN Dive and Travel Medical Guide.

Hypothermia is a condition of reduced body core temperature, defined as a temperature below 95°F (35°C). Exposure to cold results in heat loss at a rate dependent on several variables, including:

- protective clothing
- the temperature gradient between skin and the environment
- the heat capacity of the environment (much greater for water than air);
- body structure (lean versus fat fractions and mass-to-surface area)
- wind or water movement.

Water conducts heat 20-27 times faster than air. Sudden exposure to water colder than 59°F (15°C) with no thermal protection results in an involuntary gasping response. This can cause inhalation of water and cardiac dysrhythmias. In such instances, a response usually continues for one to two minutes, with extremely rapid breathing. When this happens, the hypothermic person can experience pain and mental disorientation, leading to fear and panic.

Thermal protection by a wetsuit, drysuit or other survival-type suit dramatically decreases the immediate effects, but heat loss will still occur over time. Swimming may not help. Heat production is increased by exercise or shivering, but for individuals with little or no thermal protection, swimming increases the exposed surface area and rate of heat transfer to the water. On average, swimming can help maintain core temperature in water warmer than 75°F (24°C): The core temperature of unprotected swimmers drops in colder water, resulting in an inability to continue swimming (known as swimming failure).

What If You're In 'Deep Waters'?

Persons who are immersed unprotected in cold water should remain still, holding a position to minimize exposed surface area. (Note: It's far easier to accomplish with some kind of buoyant support.) Pulling the knees together and up toward the chest – into the heat-escape-lessening position – or the "HELP" or rescue position – provides improved protection of the high heat loss areas of the armpits, groin, anterior chest, abdomen and thighs. Hypothermia can also occur in relatively warm or even tropical waters as a result of slow body cooling. This may happen in water as warm as 84-91°F (29-33°C) with no thermal protection. You may not be aware of the slow heat drain for some time. Following are the common signs (observable manifestations) and symptoms (subjective, nonobservable manifestations) of hypothermia.

Managing Hypothermia

Hypothermia may be mild, with little risk to the individual, or it may be severe, with the possibility of death. If you suspect you're dealing with a hypothermic individual, you can use a variety of rewarming strategies; they depend on the degree of hypothermic injury, the level of consciousness of the victim, the nature of other injuries and the availability of resources and additional medical aid.

The individual with mild hypothermia will be awake, conversing lucidly, complaining of cold and probably shivering. Assuming that person has no other injuries, you can rewarm a mildly hypothermic person with a variety of passive or active techniques. Remove wet clothing and replace with dry insulating inner and windproof outer layers, including the head, whenever possible. Shivering at this point will provide effective rewarming. The individual who feels comfortable exercising at this point can increase the rewarming rate by this type of movement. Exercise will transiently increase the afterdrop – a continued decline in core temperature after removal of (or from) the cold stress – but this should not be problematic in most cases of mild hypothermia. The fully alert and cooperative hypothermic individual can have warm liquids to drink. This delivers negligible amounts of heat but will help to correct the inevitable dehydration and provide a sense of comfort.

Most beverages can be used, but avoid alcohol: It can compromise awareness and contribute to dehydration and inappropriate vasodilatation. Light snacks can help, too. Food helps augment the individual's caloric reserves. The person with moderate hypothermia will be awake but may be confused, apathetic or uncooperative and have difficulty speaking. Moderate hypothermia demands more caution since this injury can lead to cardiac dysrhythmias. If at all possible, use gentle handling and active techniques such as heated blankets, forced-air rewarming and heated and humidified breathing.

Physical exercise is not recommended with the moderately hypothermic person. Physical coordination is likely compromised, and exercise at this point may increase the potential for afterdrop. When it occurs, afterdrop can increase the risk of physiological collapse sometimes observed during or shortly after rescue from immersion (called circum-rescue or post-immersion collapse). Handle hypothermic individuals gently, including keeping them supine (at rest, on the back) and completely at rest; this reduces the risk of collapse. Be attentive, and use the most effective alternatives at hand when rewarming. Take care to insulate injured persons from the ground or surroundings, even if they do not communicate the need.

A warm-water bath is another good option for the moderately hypothermic individual. You will need to provide physical support, however, throughout the transfer and immersion. The initial immersion temperature should be lukewarm, definitely not more than 105°F (40°C), to avoid the sensation of burning that the person would likely experience. After immersion, the water temperature can be progressively increased, but to no more than 113°F (45°C) to avoid burns. If hot water is not available, augment insulated clothing with chemical packs or electric pads.

To avoid burns, never apply these directly to the skin. The person with severe hypothermia may be unconscious, with a slow heart rate and respiration, or may even appear dead, with no detectable heartbeat. Look very carefully for signs of life, such as breathing, movement, or a pulse at the groin or in the neck over the carotid artery. Assess breathing and check the pulse for a period of at least one minute to confirm respiratory arrest or pulseless cardiac arrest, which requires CPR. If there is either breathing or heartbeat, external heart massage (chest compression) is not needed.

If you observe breathing or movement, then the individual's heart is beating, even if it's very slow. Because of this, it's essential to spend sufficient time checking for spontaneous pulse. For the unconscious hypothermic individual, the main goals are to maintain adequate blood pressure and respiration and to

prevent further heat loss. If the breathing rate is six breaths or fewer per minute, then start very gentle mouth-to-mouth breathing at a slow rate. Severe hypothermia leaves the individual susceptible to cardiac arrest. Extremely gentle handling – supine position, fully supported, no physical activity – and aggressive (and often invasive) rewarming strategies are required to save severely hypothermic persons.

The heart is especially susceptible in these cases: the severe cold can lead to cardiac arrhythmias, but rewarming too aggressively can also trigger them. In most cases of severe hypothermia, basic life support takes precedence over efforts to rewarm. Death from cold-water immersion usually results from loss of consciousness and subsequent drowning. If drowning preceded the hypothermia, then successful resuscitation is unlikely. If there are no signs of life, begin CPR and make arrangements for emergency transport to the nearest medical facility. Complete rewarming of the individual with severe hypothermia is almost impossible to accomplish in the field. Protect against further heat loss, however. If CPR is required, it should be continued, if possible, until medical assistance arrives.

There have been successful resuscitations after prolonged CPR, in part, because of the protective effect of hypothermia. The outlook is poor in adults who have a core temperature below 82°F (28°C), have been immersed more than 50 minutes, have life-threatening injuries or are more than four hours from definitive medical care. Although injured persons can appear to be clinically dead because of marked depression of the brain and cardiovascular function, full resuscitation with intact neurological recovery is possible, if unusual.

What To Do

In the hypothermic individual, discontinue CPR only if:

- the person is successfully resuscitated
- rescuers become too fatigued to continue
- the person has completely rewarmed and is still unresponsive to properly apply CPR.

A medically trained and qualified individual arrives at the scene and, after examination, declares the person dead.

In a Cold-Water Immersion Incident DO

- Assess ABCs – the airway, breathing and circulation of the injured person.
- If CPR is required, continue until EMS arrives.
- Give as much oxygen as possible.
- Determine cause for immersion.
- Support and immobilize neck if injury is suspected.
- Arrange transport to a medical facility.
- Prevent further heat loss.
- Rewarm if needed.

DO NOT

- Risk your life in a rescue attempt.
- Interrupt CPR unnecessarily.

Prevention

The prevention of hypothermia requires preparation. The diver must understand the use of protective

garments to conserve body heat and control heat loss. Most divers will benefit from wearing thermal protection in water cooler than 80°F (27°C). Significant thermal stress can be expected in water colder than 75°F (24°C). Divers should ensure that they have the proper protective equipment and experience to dive safely in cool or cold waters. Don't let the cold keep you out of the water. Just be prepared when you go.

Signs & Symptoms of Hypothermia

MILD HYPOTHERMIA

(core temperature 90-95°F / 32-35°C)

- Increased heart rate.
- Impaired coordination.
- Uncomfortably cold.
- Impaired ability to concentrate.
- Shivering.
- Introversion/inattentiveness.
- Decreased motor activity.
- Fatigue.

MODERATE HYPOTHERMIA

(core temperature 82-90°F / 28-32°C)

- Increasing lack of muscular coordination.
- Stumbling gait.
- Slurred speech.
- Confusion.
- Amnesia.
- Shivering slows or stops.
- Weakness.
- Drowsiness.
- Hallucinations.

SEVERE HYPOTHERMIA

(core temperature below 82°F / 28°C)

- Inability to follow commands.
- Decreased heart rate.
- Inability to walk.
- Loss of consciousness.
- Decreased respirations.
- Absence of shivering.
- Dilated pupils.
- Decreased blood pressure.
- Appearance of death.
- Muscle rigidity.