

I01: Hypothermia

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Reviewed:

Introduction

Hypothermia is defined as a drop in body core temperature below 35 degrees Celsius. Peripheral thermometers are of limited utility in hypothermia – they can be inaccurate and vary by up to 2°C – but their readings can provide paramedics with valuable data with respect to trends. Because core temperature probes (either rectal or esophageal) are generally unavailable in a prehospital setting, recognition of the different stages of hypothermia is more important than an understanding of the exact boundaries.

General hypothermia management consists of removing the patient from the cold environment, ensuring the patient is dry, and to prevent further heat loss. Paramedics should handle patients gently, and attempt to keep them supine whenever possible.

Essentials

Although patient presentations can vary widely, the signs and symptoms of hypothermia can be divided into three categories:

- Mild hypothermia is defined as a core temperature between 32°C and 35°C. These patients have a normal mental status with shivering, tachypnea, tachycardia, initial hyperventilation, ataxia, jumbled speech, impaired judgment, and "cold diuresis."
- Moderate hypothermia features a core temperature between 28°C and 32°C. Patients present with an altered mental status and are no longer shivering. Lower heart rates, and an attendant reduction in cardiac output are common; atrial fibrillation, junctional bradycardias, or other dysrhythmias can develop. Respiratory rates fall, and hyporeflexia can occur as a result of central nervous system depression. The altered mental status may cause patients to remove clothing.
- Severe hypothermia features a core temperature between 24°C and 28°C. Unconsciousness, hypotension, and bradycardia are common. Pulmonary edema can develop, as can ventricular dysrhythmias or asystole.

Additional Treatment Information

WARNING: HYPOTHERMIA IS A SIGNIFICANT CONTRIBUTOR TO MORTALITY IN TRAUMA

In general, patients should be treated in a step-wise manner, beginning with less aggressive rewarming techniques. "Passive rewarming," through the use of blankets around the body and the head, coupled with "active rewarming" using heated IV solutions, offers an effective initial strategy for most patients who are perfusing effectively.

While environmental exposure may trigger an assessment for hypothermia, paramedics are cautioned that other groups of patients may be at risk for developing hypothermia in atypical environments. Clinical problems that produce an altered level of consciousness can eventually result in hypothermia, including (but not limited to) behavioural or psychiatric problems, prolonged seizures, alcohol or drug intoxication, strokes and cerebrovascular accidents, and diabetic or other metabolic emergencies. Elderly or frail individuals who are "found down" in their homes are at significant risk for developing hypothermia. Paramedics must perform comprehensive assessments, and treat identified conditions concurrently with the hypothermia.

Depending on the degree of thermogenesis from shivering, the rewarming rate for patients may be anywhere from 0.5°C to 2°C per hour. The addition of active rewarming measures, using insulated or wrapped heat packs applied to the torso (groin, sides of chest, back of neck, small of back, and axilla) will significantly improve comfort and may lessen thermal stress.

Do not attempt to re-warm frozen or frostbitten limbs.

Hypotension can result from decreased cardiac output. Fluid shifts into the extracellular space are common, producing dehydration. Vascular access is indicated in hypothermia, with warmed saline (between 37°C and 42°C) as the fluid of choice if available. In the prehospital environment, it can be difficult to warm or measure the

temperature of fluids; paramedics are cautioned that "room temperature" fluids will significantly worsen hypothermia.

Referral Information

Mildly hypothermic patients with no concurrent clinical problems, whose condition is improving, can be released into self-care or care of others to continue rewarming process.

General Information

Hypothermic patients have significantly reduced metabolic demands, and have dramatic reductions in heart and respiratory rates. 30 to 45 seconds should be taken to accurately assess spontaneous respiration and pulse. Afterdrop, a rare phenomenon where cold blood from the extremities returns to the core, can occur producing an additional drop in core temperature.

Electrocardiogram findings in hypothermia can include J or Osborn waves (positive deflections following the QRS complex), most prominently in V₂ through V₅. The height of the wave is roughly proportional the degree of hypothermia, though these are non-specific and may be due to other clinical phenomena.

Interventions

First Responder

- At all times: handle patients gently
- Remove from cold environment, remove wet clothes, and prevent further heat loss
- Initiate passive rewarming with blankets
- Assess for concurrent injuries or conditions and treat as required

Emergency Medical Responder – All FR interventions, plus:

- Obtain baseline vital signs, including temperature where possible
- Consider active rewarming measures (e.g., wrapped hot packs) for moderate hypothermia

Primary Care Paramedic – All FR and EMR interventions, plus:

- Establish vascular access
 - [→ D03: Vascular Access](#)
- If available, warmed saline (37°C-42°C) for hypotension (30 ml/kg, maximum 2 L)
- Obtain capillary blood glucose and treat as required
 - [→ E01: Hypoglycemia and Hyperglycemia](#)
- In cardiac arrest: consider transportation to hospital capable of extracorporeal blood rewarming if within 90 minutes

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Attach cardiac monitor
- Obtain and interpret 12-lead electrocardiogram
 - [→ PR16: 12 Lead ECG](#)
- Consider transcutaneous pacing for persistent bradycardia if core temperature is between 32°C and 35°C
 - [→ PR19: Transcutaneous Pacing](#)

Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Vasopressors may be necessary to support blood pressure
- Rhabdomyolysis and multi-organ system failure can develop during rewarming process
- Consider transport to center capable of extracorporeal blood rewarming (ECMO) in cases of severe hypothermia

refractory to treatment

- Review [BC Accidental Hypothermia treatment guideline-](#)

Evidence Based Practice

[Hypothermia](#)

I02: Hyperthermia

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Introduction

Heat related illnesses are characterized by hyperthermia (a core temperature over 40°C) and central nervous system disturbances, and can be life-threatening conditions. They can be considered a form of systemic inflammatory response that affects multiple organ systems, which in many ways resembles sepsis. These illnesses can be categorized into three groups: heat cramps, heat exhaustion, and heat stroke.

Note: this guideline is intended to assist paramedics in managing heat from exogenous sources. It is not to be used to manage fever.

Essentials

- Heat cramps are painful muscle spasms due to hyponatremia, associated with strenuous activity. Patients have a normal body temperature, with no evidence of dehydration.
- Heat exhaustion develops over hours to days, and is associated with fluid and electrolyte losses due to sweating with inadequate replacement. Patients have a normal mental status, though they may be light-headed, nauseated, tachypneic, and complaining of a headache. Body temperature is normal, or slightly elevated. Hypotension can be present, and may cause tachycardia.
- Heat stroke can be divided into two sub-types:
 - Classic (non-exertional) heat stroke occurring in the elderly with high ambient temperature. Can develop over hours to days from passive fluid losses by sweating. Classic heat stroke carries a high mortality rate. Mortality correlates with the degree of temperature elevation, time to initiation of cooling measures, and the number of organ systems affected.
 - Exertional heat stroke develops due to extreme environmental conditions combine with high metabolic rates of heat production to overwhelm the body's ability to lose heat. Generally seen in fit populations during exertional activities (e.g. long distance runners, firefighters, soldiers) especially when high humidity limits heat loss. Occurs when the body's thermoregulation defences are exhausted and is a true medical emergency.
- Both types of heat stroke can present with sudden loss of consciousness, irritability, seizures, ataxia, hallucinations, hemiplegia and coma. Patients may stop sweating in either case (and is a late sign of heat stroke). Rhabdomyolysis may complicate management.

Additional Treatment Information

- The basic treatments for heat emergencies are the same across all license levels, and vary only in the case of critically ill patients suspected of heat stroke
- The management of classic heat stroke consists of ensuring adequate airway protection, breathing, and circulation, rapid active cooling, and treatment of complications
- Recommended treatment for exertional heat stroke includes whole-body cold-water immersion (CWI). However, remote locations or monetary or spatial restrictions can challenge the feasibility of CWI.
- A patient with a body temperature below 40°C can generally be managed using basic cooling techniques alone. Sheltering and removal from the heat source, removing all clothing except for underwear, and ensuring airflow over the patient comprise the initial actions. Spray bottles of water, or wet towels, can also be used to help cool patients; these should be continued until the core temperature is < 38°C.
- In more severe cases (i.e., a core temperature above 40°C), more aggressive interventions should be considered. Cool intravenous fluids can be considered in these instances, and should be given if the patient is significantly dehydrated, or if signs of poor perfusion are present. As with all instances of fluid replacement, caution should be exercised. Although the therapeutic endpoints for fluid resuscitation are not well defined, 10 mL/kg is suggested as an initial goal; consultation with ClinCall for additional guidance is recommended.
- Do not give antipyretics. Hyperthermia is distinct from fever in that the heat source is exogenous – the hypothalamus' set point is not affected.
- Be sure to differentiate shaking and tremors from seizures. Manage seizures in accordance with CPG [F02: Seizures](#).

Referral Information

Heat exhaustion that responds to treatment within 15 minutes can be left in care of family.

Interventions

First Responder

- Ensure optimal oxygenation and ventilation
 - → [A07: Oxygen and Medication Administration](#)
 - → [B01: Airway Management](#)
- Shelter or otherwise remove patient from heat source
- Remove all clothing except underwear and ensuring airflow over patient
- Tepid water using spray bottles or wet towels can also be used

Primary Care Paramedic – All FR and EMR interventions, plus:

- Consider vascular access and need for fluid replacement
 - → [D03: Vascular Access](#)
- Assess capillary blood glucose. Correct hypoglycemia as required
 - → [E01: Diabetic Emergencies](#)
- For obtunded, unresponsive patients, consider supraglottic airway
 - → [PR08: Supraglottic Airways](#)

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Consider anticonvulsant
 - → [F02: Seizures](#)
- Consider endotracheal intubation in unresponsive patients
 - → [PR18: Anesthesia Induction](#)

Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Consider neuromuscular blocker

Evidence Based Practice

[Hyperthermia](#)

I03: Dive / Scuba Injuries

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Introduction

Although scuba divers can experience a myriad of injuries from wildlife and trauma, the two most serious forms of diving injuries are decompression sickness (DCS) and arterial gas embolism (AGE), both of which are directly related to the behavior of pressurized gases. In many cases, the signs and symptoms of decompression sickness and gas emboli overlap significantly; it is not important to differentiate between the two in the prehospital environment, and the treatment for both is essentially identical.

Decompression Sickness ("the bends")

Scuba divers breathe compressed air. At depth, the nitrogen in this air dissolves into the bloodstream, and diffuses into body tissues at variable rates. The water pressure around the diver keeps this gas dissolved in the blood and tissues, but as a diver ascends, water pressure decreases, which allows the dissolved gases to come out of solution. (This is similar to opening a pop can – the carbon dioxide remains in the liquid because of the pressure inside the can – and the behavior of gases under pressure is described by Henry's Law.) Normally, during an ascent, divers change depths slowly and breathe constantly ensuring that the nitrogen is released from their lungs, but under some circumstances – a rapid ascent from too deep a dive, for instance – the dissolved gas may not diffuse into the lungs and may instead accumulate in the blood, musculoskeletal system, or other body tissues as bubbles.

Type 1 DCS is limited to the capillaries of the skin, lymphatic vessels, and the musculoskeletal system. It generally includes skin rashes or urticarial and joint pain. In its milder form, the symptoms can be fleeting and last only a few minutes as the bubbles break down and the diver off-gases; these do not generally require treatment. Pain at or around joints is rarely symmetrical. In more severe cases, the pain can increase over 12 to 24 hours after surfacing, and if untreated, will resolve slowly over the next three to seven days to a dull ache.

Type 2 DCS is more serious. It involves the central nervous, cardiovascular, and respiratory systems; common symptoms include headache, blurred vision, nausea, dizziness, and ataxia. Shortness of breath, hypotension, and weakness can occur. In many cases, Type 1 symptoms are also present.

Arterial Gas Embolism

The pressurized gas breathed by a diver at depth expands as she ascends, following the relationship described by Boyle's Law. If the expansion is not accommodated or controlled, the expansion can be fatal. In the lungs, gas can expand and rupture alveoli, introducing air into the bloodstream. Once in the blood, the bolus of air is carried into the heart, and then into the arterial circulation. Air can also be forced into the pleural space between the lungs and chest wall; in some cases, this is the result of a congenital weakness. Pleural air expansion can lead to either mediastinal emphysema (a collection of air in the mediastinum) or subcutaneous emphysema in the neck or upper chest.

Arterial gas embolisms are the most common cause of death in scuba diving.

Essentials

- Decompression sickness should be considered in any diver who, within 24 hours of completing a dive, complains of a persistent headache, dizziness, joint pain, or difficulty balancing. Most DCS cases are mild and treatment is often successful, but recognition can be difficult and expert consultation is required.
- Arterial gas embolisms are sudden, catastrophic events that become obvious upon surfacing. A diver who surfaces in distress should be assumed to have an arterial gas embolism or other barotrauma until proven otherwise.

Additional Treatment Information

- The immediate history of the dive can provide clues to the probability of decompression sickness. Some of the risk factors include:

- Strenuous work at depth
- Deep dives on air only (i.e., no mixed gas)
- Long bottom times
- Cold water dives
- Repetitive dives
- Missed or shortened safety stops
- Dehydration and/or recent alcohol consumption
- Individual susceptibility to DCS is not well understood, and the phenomenon is not predictable. Divers can strictly follow tables and use computers to monitor their dives, and still develop DCS. Every dive carries some risk of DCS, and the absence of risk factors on any given dive does not preclude the possibility of the disorder. A diver demonstrating symptoms consistent with DCS, and who lacks any of the risk factors listed above, should still be considered a potential diving injury until appropriately assessed.
- Individuals who have experienced DCS are at significant risk of subsequent episodes. A prior history of a patent foramen ovale or other structural heart disease resulting in a right-to-left intracardiac shunt is also at high risk of developing DCS.
- Although joint pain within 30 minutes of surfacing is considered a classic symptom of DCS, headaches and flu-like symptoms are also common. Joints commonly involved include the shoulders and elbows and the pain is not significantly worse with movement. These symptoms may take up to 24 hours to develop. Joint pain often resolves in several days.
- Arterial gas embolisms are often associated with rapid, buoyant ascents as might occur when a diver panics; breath holding during an ascent is a common cause. An AGE is an abrupt onset event: divers may be in obvious difficulty on the surface. The development of symptoms beyond 10 minutes post-dive is unlikely to be due to an AGE (consider DCS in this case).
 - Signs and symptoms of arterial gas embolism include:
 - Collapse and unconsciousness
 - Seizures
 - Visual field disturbances or blindness
 - Weakness or paralysis
 - Disorientation
 - Bloody, frothy sputum
 - Chest pain
 - Shortness of breath
 - Barotrauma can occur when compressed gas becomes trapped in a space in the body such as a dental filling, sinus, or the middle or inner ear. Pain and bleeding are common; dizziness, vertigo, and loss of hearing in the affected ear may be present as well.
 - Carbon monoxide toxicity can develop from breathing contaminated air, either in the scuba tank itself, or in the air on a boat. Treat in accordance with CPG J04.
 - Every breathing gas mixture has a critical limit, below which the oxygen becomes toxic. For air, that limit is roughly 200 feet; as the concentration of oxygen in the breathing mixture increases, the limit becomes shallower. Oxygen toxicity develops only in the context of increased partial gas pressures (i.e., it does not happen at atmospheric pressure), and can cause dizziness, nausea, facial tics, visual field disturbances, or seizures. These often develop at depth and remain present upon surfacing. Distinguishing between oxygen toxicity and DCS can be difficult, though a history of the dive (depth, breathing gas mixture) will help.
 - Marine life can cause a variety of injuries ranging from punctures and lacerations to venomous stings. Follow standard wound care procedures in managing these types of injuries.
 - In jellyfish stings, flush the affected area using seawater, as fresh water can cause the nematocysts to fire. Do not use vinegar or other fluids for stings occurring in Canadian coastal waters. After flushing, paramedics should attempt to cautiously, and gently, remove any remaining tentacles by scraping with the dull edge of a knife or plastic card.

Referral Information

Signs of decompression sickness can be subtle, and may take time to develop. An emergency physician should always see patients suspected of having suffered a dive injury. Consultation with a specialist in hyperbaric

medicine is highly recommended.

General Information

- Deliver oxygen at the highest possible percentage and flow rates to symptomatic patients. Continue providing oxygen even if symptoms appear to resolve. Use a non-rebreathing face mask, or bag-valve mask with reservoir. CPAP and PEEP are contraindicated due to the risk of exacerbating an underlying barotrauma.
- To the maximum extent possible patients should be kept supine. If required to protect the airway, an injured diver may be positioned laterally, left side down.
- Dive injuries can be multifaceted. Hypothermia can complicate management, and physical trauma sustained during the dive must be addressed. Do not focus on dive-related injuries to the exclusion of other clinical problems.
- The sole hyperbaric chamber accessible to civilians in the province of British Columbia is at Vancouver General Hospital. Follow destination guidelines – recompression therapy must be coordinated with the hyperbaric unit at VGH prior to patient arrival at the facility; in the absence of traumatic injuries requiring a trauma centre, patients should be transported to their nearest facility for assessment and referral. If the patient is to be flown to VGH, cabin altitude should be kept below 1,000' where possible.
- When communicating with other health care providers, paramedics must be clear about terminology: these patients have experienced a dive injury or a scuba injury, not a diving injury.
- Paramedics should make a concerted effort at gathering information relating to the dive, interviewing the injured diver's buddy, and securing the diver's gear (particularly any computer or monitoring equipment that recorded the depth profile).

Interventions

First Responder

- Provide high flow oxygen
 - → [A07: Oxygen and Drug Administration](#)
 - → [B01: Airway Management](#)

Emergency Medical Responder – All FR interventions, plus:

- Obtain thorough dive history
- Position patient supine where possible

Evidence Based Practice

[Diving Injury \(Decompression Sickness or Bends\)](#)

References

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