Hypothermia and Cold Exposure

Aliases

Hypothermia, frost bite, cold induced injuries

Patient Care Goals

1. Maintain hemodynamic stability.
2. Prevent further heat loss.
3. Rewarm the patient in a safe manner.
4. Manage hypothermia induced cardiac arrest appropriately.
5. Prevent loss of limbs.

Patient Presentation

1. Patients may suffer from hypothermia due to exposure to a cold environment (increased heat loss) or may suffer from a primary illness or injury that, in combination with cold exposure (heat loss in combination with decreased heat production), leads to hypothermia.
2. Patients may suffer systemic effects from cold (hypothermia) or localized effects (e.g. frostbite).
3. Patients with mild hypothermia will have normal mental status, shivering, and may have normal vital signs while patients with moderate to severe hypothermia will manifest mental status changes, eventual loss of shivering, and progressive bradycardia, hypotension, and decreased respiratory status.
4. Patients with frostbite will develop numbness involving the affected body part along with a "clumsy" feeling and areas of blanched skin. Later findings include a "woody" sensation, decreased or loss of sensation, bruising or blister formation, or a white and waxy appearance to affected tissue.

Inclusion Criteria

Patients suffering systemic or localized cold injuries

Exclusion Criteria

1. Patients without cold exposure
   OR
2. Patients with cold exposure but no symptoms referable to hypothermia or frostbite

Patient Management

Assessment

1. Begin with the primary survey, looking for evidence of circulatory collapse and ensuring effective respirations.
    a. The patient suffering from moderate or severe hypothermia may have severe alterations in vital signs including weak and extremely slow pulses, profound hypotension and decreased respirations.
    b. The rescuer may need to evaluate the hypothermic patient for longer than the normothermic patient (up to 60 seconds).
2. Obtain standard SAMPLE-type patient history.
3. Obtain additional history, including:
    a. Any associated injury or illness.
    b. Duration of cold exposure.
    c. Ambient temperature.
    d. Any treatments initiated before EMS arrival.
4. Categorize the severity of hypothermia based on core body temperature readings and clinical evaluation.
    a. Body temperature: Perform, if possible and reliable, core body temperature measurements and categorize patients into one of the four following levels of hypothermia:

- Mild: normal body temperature 35–32.1°C (95–89.8°F)
- Moderate: 32°–28°C (89.7°–82.5°F)
- Severe: 28°–24°C (82.4°–75.2°F)
- Profound: less than 24°C (75.2°F)

b. Balance the above temperature-based categorization against the following clinical findings, as these are equally important:
   - Mild: vital signs not depressed normal mental status, shivering is preserved; body maintains ability to control temperature
   - Moderate to severe: progressive bradycardia, hypotension, and decreased respirations, alterations in mental status with eventual coma, shivering will be lost in moderate hypothermia (generally between 31-30° C), and general slowing of bodily functions; the body loses ability to thermo-regulate

Treatment and Interventions

1. Maintain patient and rescuer safety—the patient has fallen victim to cold injury and rescuers have likely had to enter the same environment. Maintain rescuer safety by preventing cold injury to rescuers.
2. Manage airway per the Airway Management guideline.
3. Initiate interventions according to severity of patient condition (a. Mild, b. Moderate or Severe, or b. Frostbite):
   a. **Mild hypothermia:**
      i. Remove the patient from the environment and prevent further heat loss by removing wet clothes and drying skin; insulate from the ground; shelter the patient from wind and wet conditions; and insulate the patient with dry clothing or a hypothermia wrap or blanket. Cover the patient with a vapor barrier and, if available, move the patient to a warm environment.
      ii. Assess patient need for oxygen.
         - Hypothermic patients have decreased oxygen needs and may not require supplemental oxygen.
         - If oxygen is deemed necessary, it should be warmed, to a maximum temperature between 40–42°C (104– 108°F) and humidified if possible.
      iii. Fuel shivering through caloric replacement. Vigorous shivering can substantially increase heat production.
         - Provide beverages or foods containing glucose if feasible and patient is awake and able to manage airway independently.
      iv. Consider field-rewarming methods such as placement of large heat packs or heat blankets (chemical or electric if feasible) to the anterior chest or wrapped around the patient's thorax if large enough. Forced air warming blankets (e.g. Bair Hugger®) can be an effective field rewarming method if available.
      v. Monitor frequently—if temperature or level of consciousness decreases, refer to Severe Hypothermia.
      vi. Consider isotonic IV/IO fluid bolus 20 ml/kg ***[AEMT]***
         - Indications for IV access and IV fluids in the mildly hypothermic patient are similar to those of the non- hypothermic patient.
         - IV fluids, if administered, should be warmed, ideally to 42°C.
         - Normal saline bolus therapy 20 mg/kg is preferable to continuous drip.
         - The recommended fluid for volume replacement in the hypothermic patient is normal saline.
      vii. If alterations in mental status, consider measuring blood and treat as indicated (treat per Hypoglycemia or Hyperglycemia guidelines) and assess for other causes of alterations of mentation.
      viii. Transport to a hospital capable of rewarming the patient.
   b. **Moderate or severe hypothermia:**
      i. Perform ABCs—pulse checks for patients suffering hypothermia should be performed for 60 second—and obtain core temperature if possible for patients

exhibiting signs or symptoms of moderate or severe hypothermia.
    - Rectal temperatures may also be used, but only once the patient is in a warm environment. Rectal temperatures are not reliable or suitable for taking temperatures in the field and should only be done in a warm environment (such as a heated ambulance).

ii. Manage airway as needed.
    - Care must be taken not to hyperventilate the patient as hypocarbia may reduce the threshold for ventricular fibrillation in the cold patient.
    - Indications and contraindications for advanced airway devices are similar in the hypothermic patient as in the normothermic patient.

iii. Prevent further heat loss by removing the patient from the environment and removing wet clothes and drying skin, insulate from the ground, shelter the patient from wind and wet conditions, and insulate the patient with dry clothing or a hypothermia wrap or blanket. Cover the patient with a vapor barrier and, if available, move the patient to a warm environment.

iv. Initiate field-rewarming methods such as placement of large heat packs or heat blankets (chemical or electric if feasible) to the anterior chest or wrapped around the patient's thorax if large enough.
    - Never apply chemical or electrical heat sources directly to the skin.
    - Use a barrier between the skin and heat source to prevent burns.
    - Use forced air warming blankets (e.g. Bair Hugger®), if available; they can be an effective field rewarming method.

v. Handle the patient gently.
    - Attempt to keep the patient in the horizontal position, especially limiting motion of the extremities to avoid increasing return of cold blood to the heart.
    - Once in a warm environment, clothing should be cut off (rather than removed by manipulating the extremities).
    - Move the patient only when necessary such as to remove the patient from the elements.

vi. Apply ECG cardiac monitor or AED if available.

vii. Establish IV and provide warmed NS bolus 20 mg/kg ***[AEMT]*** – Repeat as necessary.

viii. If alterations in mental status, consider measuring blood glucose and treat as indicated (treat per Hypoglycemia or Hyperglycemia guidelines) and assess for other causes of alterations of mentation.

ix. Transport as soon as possible to a hospital capable of resuscitation. If cardiac arrest develops, consider transport to a center capable of extracorporeal circulation (ECMO) or cardiopulmonary bypass (if feasible).

x. Warm the patient compartment of the ambulance to 24°C (75.2°F) during transport.

c. **Frostbite:**

i. Avoid rewarming of extremities until definitive treatment is possible, if ambulation or travel is necessary for evacuation or safety. Additive injury occurs when the area of frostbite is rewarmed and then inadvertently refrozen. Only initiate rewarming if refreezing is absolutely preventable.
    - If rewarming is feasible and refreezing can be prevented, use circulating warm water (37–39°C or 98.6–102°F) to rewarm effected body part, and thaw injury completely. If warm water is not available, rewarm frostbitten parts by contact with non- affected body surfaces. Do not rub or cause physical trauma.
    - After rewarming, cover injured parts with loose, sterile dressing. If blisters are causing significant pain, and the provider is so trained, these may be aspirated, however, should not be de- roofed. Do not allow injury to refreeze. Treat per the Pain Management guideline.

Patient Safety Considerations

1. Given the additive effects of additional cold stress, the patient should be removed from the cold environment as soon as operationally feasible.
2. In patients suffering from moderate to severe hypothermia, it is critical to not allow these patients to stand or exercise as this may cause circulatory collapse.
3. Devices that self-generate heat (e.g. heat packs) and are being utilized during the rewarming process should be wrapped in a barrier to avoid direct contact with the skin and to prevent burns. Available evidence suggests that heat packs with peak temperatures above 45°C (113°F) are most likely to cause burns. In patients who are unresponsive, or unable to recognize a developing injury, please check the area in which the heating pad is placed regularly to ensure no tissue damage occurs.

Notes and Educational Pearls Key Considerations

Considerations in cardiac arrest associated with hypothermia.

- The following are contraindications for initiation of resuscitation in the hypothermic patient:
    - Obvious fatal injuries (such as decapitation)
    - The patient exhibits signs of being frozen (such as ice formation in the airway)
    - Chest wall rigidity such that compressions are impossible
    - Danger to rescuers or rescuer exhaustion
    - Avalanche victims buried for 35 minutes or longer with airway obstruction by ice or snow
- Recognize that fixed and dilated pupils, apparent rigor mortis, and dependent lividity may not be contraindication for resuscitation in the severely hypothermic patient.
- The mainstay of therapy in severe hypothermia and cardiac arrest should be effective chest compressions and attempts at rewarming.
    - **Note:** Chest compressions should be provided at the same rate as in normothermic patients.
- The temperature at which defibrillation should first be attempted in the severely hypothermic cardiac arrest victim and the number of defibrillation attempts is unclear. There are different approaches regarding resuscitation of the hypothermic arrest patient.
    - Per the American Heart Association (AHA), if the patient has a shockable rhythm (VF/VT), defibrillation should be attempted. It is reasonable to continue defibrillation attempts per AHA protocols concurrently with rewarming strategies.
    - If defibrillation is unsuccessful and the patient's core temperature is greater than 30°C (86°F), follow guidelines for normothermic patients.
    - If available monitors reveal asystole, CPR alone is the mainstay of therapy.
    - If monitoring reveals an organized rhythm (other than VF or VT) and no pulses are detected, do not start CPR, but continue to monitor.
        - While this may represent pulseless electrical activity (PEA), this may also represent situations in which the patient's pulses are not detectable but remain effective due to decreased metabolic needs.
        - In the case of PEA, the rhythm will deteriorate rapidly to asystole, in which case, CPR should be initiated.
    - Given the potential to cause VF with chest compressions, the Alaska guidance offers that it is better to maintain effective cardiac activity than to start CPR and cause VF.

- Manage the airway per standard care in cardiac arrest victims [see Cardiac Arrest guideline].
    - In the absence of advanced airways, ventilate the patient at the same rate as a normothermic patient.
    - If the patient has an advanced airway, ventilate at half the rate recommended for a normothermic patient to prevent hyperventilation. If $ETCO_2$ is available, ventilate to maintain normal $ETCO_2$ levels.
    - There is little evidence to guide use of medications in severe hypothermia with cardiac arrest, however 2010 AHA updates to advanced cardiac life support recommend use of vasopressors according to standard ACLS protocols.

    - Above 30°C (86°F), intervals between medication provision should be doubled until the patient reaches 35°C (95°F), at which time, normal medication intervals may be adopted.
- Upon ROSC, treat per Adult Post-ROSC guideline.
- Patients with severe hypothermia and arrest may benefit from resuscitation even after prolonged downtime, and survival with intact neurologic function has been observed even after prolonged resuscitation.
    - **Note:** Patients should not be considered deceased until rewarming has been attempted.
- If a hypothermic patient clearly suffered cardiac arrest and subsequently became hypothermic afterward with prolonged down time between arrest and rescue, there is no rationale for initiating resuscitation and warming the patient.

Pertinent Assessment Findings

1. Identification of associated traumatic injuries (when present)
2. Identification of localized freezing injuries
3. Patient core temperature (when available)

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914023—Environmental-Cold Exposure
- 9914031—Environmental-Hypothermia
- 9914025—Environmental-Frostbite/Cold Injury

Key Documentation Elements

- Duration of cold exposure
- Ambient temperature and recent range of temperatures
- Rewarming attempts or other therapies performed prior to EMS arrival
- Patient use of alcohol or drugs

Performance Measures

- Patient core temperature and means of measurement (when available)
- Presence of cardiac dysrhythmias
- Documentation of associated trauma (when present)
- Blood glucose level obtained
- ***EMS Compass® Measures*** *(for additional information, see www.emscompass.org)*
    - *Hypoglycemia-01: Treatment administered for hypoglycemia.* Measure of patients who received treatment to correct their hypoglycemia
    - *Trauma-01: Pain assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain
    - *Trauma-02: Pain re-assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain

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