Take-Home Points

Hypothermia occurs whenever exposure to cold causes a drop in body core temperature to below 35 °C (95°F). Although classically associated with outdoor activities occurring in winter months, about half of all hypothermia deaths occur in the elderly with the homeless, drug/alcohol abusers, and mentally ill also at high risk. Depending on core body temperature, hypothermia can be classified as being mild, moderate or severe. The following table differentiates among these levels of hypothermia and their typical clinical findings.

<table>
<thead>
<tr>
<th>Severity</th>
<th>Core Temp</th>
<th>Common Clinical Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>32-35°C (90-95°F)</td>
<td>Tachypnea, tachycardia, increased BP, confusion, ataxia, dysarthria, shivering, excessive diuresis</td>
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<tr>
<td>Moderate</td>
<td>28-32°C (82-90°F)</td>
<td>Reduced RR, HR, CO and consciousness; hallucinations; mydriasis; loss of shivering and airway protection</td>
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<tr>
<td>Severe</td>
<td>&lt;28°C (82°F)</td>
<td>Coma, areflexia, apnea (&lt;24°C), oliguria, hypotension, pulmonary edema, bradycardia, ventricular arrhythmias, asystole (&lt;20°C)</td>
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</tbody>
</table>

BP = blood pressure; RR = respiratory rate; HR = heart rate; CO = cardiac output

Key management pointers for patients admitted with accidental hypothermia include the following:

Assessment/Information Gathering

- Assess for pulse and respirations using standard BLS techniques (both may be slow or difficult to detect); if no signs of life, immediately begin CPR.
- Quickly gather an immediate past history to confirm cold exposure as the causal event and rule out other possibilities, e.g., intoxication/drug overdose, stroke, brain trauma.
- Recommend measurement of the patient's core temperature using a low-temperature probe placed in the esophagus, bladder, or rectum (for accuracy rectal probes must not be placed in stool).
- Recommend electrolytes (K+ levels are critical), glucose (to rule out hypoglycemia as cause), BUN and creatinine (to assess renal function), creatine phosphokinase (to assess for diffuse cellular injury), coagulation panel (hypothermia inhibits blood coagulation), ETOH and drug screen.
- Obtain/monitor pulse O2 saturation but note that peripheral vasoconstriction may affect the accuracy of digital probe data-consider using ear or forehead probe instead.
- Obtain an ABG and assess/apply the values uncorrected for temperature, i.e., ventilation should be adjusted to maintain an uncorrected pH of 7.40.
- Recommend continuous ECG monitoring (may show ↑ PR, QRS, and QT intervals, and atrial or ventricular arrhythmias); however, unless VF, VT or asystole confirmed, treat patient according to perfusion status not ECG, since PEA is a common finding.
- Recommend a chest X-ray (to assess for aspiration pneumonia and pulmonary edema, both seen in accidental hypothermia).
- Recommend urinary catheterization to monitor fluid balance and assess renal sufficiency.
- Try to minimize patient manipulation, since extensive movement and invasive monitoring can cause cardiac arrhythmias.
Treatment/Decision-Making

- Remove any wet clothing, dry the skin and cover the patient with warm blankets.
- If no signs of life, immediately initiate CPR and continue until patient rewarmed to at least 32 to 34°C (death should not be declared until after assessing effect of rewarming).
- Provide warm supplemental O2 sufficient to maintain SpO2 to > 90% (use either a heated nebulizer with aerosol mask or high-flow nasal cannula for this purpose).
- If patient unresponsive or in cardiopulmonary arrest, intubate and provide ventilation, ideally with warm (40-42°C), humidified O2 (also helps prevent aspiration); monitor ECG during intubation since patients with hypothermia are prone to cardiac arrhythmias.
- For patients with V-Fib, V-Tach or PEA, recommend or implement the applicable ACLS protocol* concurrent with efforts to increase core body temperature (below); the likelihood of success is greatest at core temperatures above 30 °C.
- Recommend concurrent re-warming appropriate to the severity of hypothermia and the patient's perfusion status:
  - Mild/moderate hypothermia with a perfusing rhythm: recommend passive external warming (e.g., warm blankets)
  - Severe hypothermia with a perfusing rhythm: recommend either active external warming (e.g., forced heated air, heat lamps, or other surface-warming devices) or (better) active internal rewarming using IV solutions heated to 40-42°C, gastric lavage with warm isotonic solutions (no higher than 45°C), and heated, humidified O2 (40-42°C); to avoid aspiration, gastric lavage should not be recommend unless the patient is intubated.
  - Severe hypothermia and cardiac arrest: recommend cardiopulmonary bypass if available; if not recommend hemodialysis, thoracic/pleural lavage with warm isotonic solutions, or full-body immersion in warm water, i.e., a Hubbard tank (full-body immersion obviously not feasible during ACLS protocols).
- If the patient is hypotensive (commonly due to vasodilation), recommend warmed IV fluids and, as needed, vasopressors to elevate and maintain blood pressure.
- For patients who were pulseless, upon return of spontaneous circulation recommend continued re-warming to a core temperature of about 32° to 34°C (maintained according to standard ACLS post-arrest guidelines).
- For patients requiring mechanical ventilation:
  - Use active, heated humidification, not an HME; if humidifier temperature can be altered, set to 42-45 °C but note that this method alone provides only modest re-warming and should never be used alone.
  - Adjust minute ventilation to achieve a normal pH (7.35 - 7.45) using values uncorrected for the patient's core temperature, i.e., measured at the standard 37 °C
  - Hypothermia shifts the HbO2 dissociation curve to the left, increasing the affinity of Hb for O2 and thus impairing tissue O2 extraction; until a normal temperature is restored, this problem can be minimized by keeping the SpO2 > 90%.
  - If the patient also suffers from aspiration pneumonia (most common in hypothermia associated with ETOH intoxication/drug overdose), follow the relevant guidelines on management of drug overdose.

* the following ACLS Asystole/Pulseless Electrical Activity (PEA) protocol (with post cardiac arrest care) is applicable in this case:
Adult Cardiac Arrest Algorithm—2015 Update

1. Start CPR
   - Give oxygen
   - Attach monitor/defibrillator

2. Rhythm shockable?
   - Yes
   - VF/pVT
   - Shock
   - CPR 2 min
     - IV/IO access
     - CPR 2 min
       - Epinephrine every 3-5 min
       - Consider advanced airway, capnography
       - Rhythm shockable?
         - Yes
         - Shock
         - CPR 2 min
           - Amiodarone
           - Treat reversible causes
         - No
         - CPR 2 min
           - Treat reversible causes

   - No
   - Asystole/PEA
   - CPR 2 min
     - IV/IO access
     - CPR 2 min
       - Epinephrine every 3-5 min
       - Consider advanced airway, capnography
       - Rhythm shockable?
         - Yes
         - Shock
         - CPR 2 min
           - Amiodarone
           - Treat reversible causes
         - No
         - CPR 2 min
           - Treat reversible causes

3. CPR 2 min
   - IV/IO access

4. Rhythm shockable?
   - Yes
   - Shock
   - CPR 2 min
     - Epinephrine every 3-5 min
     - Consider advanced airway, capnography
     - Rhythm shockable?
       - Yes
       - Shock
       - CPR 2 min
         - Amiodarone
         - Treat reversible causes
       - No
       - CPR 2 min
         - Treat reversible causes

5. Rhythm shockable?
   - No
   - CPR 2 min
     - Amiodarone
     - Treat reversible causes

6. CPR 2 min
   - IV/IO access

7. Rhythm shockable?
   - Yes
   - CPR 2 min
     - Epinephrine every 3-5 min
     - Consider advanced airway, capnography
     - CPR 2 min
       - Amiodarone
       - Treat reversible causes
   - No
   - CPR 2 min
     - Treat reversible causes

8. CPR 2 min
   - Amiodarone
   - Treat reversible causes

9. CPR 2 min
   - IV/IO access

10. CPR 2 min
    - Epinephrine every 3-5 min
    - Consider advanced airway, capnography

11. Rhythm shockable?
    - Yes
    - CPR 2 min
      - Treat reversible causes
    - No
    - CPR 2 min
      - Treat reversible causes

12. Rhythm shockable?
    - No
    - CPR 2 min
      - Treat reversible causes
    - Yes
    - CPR 2 min
      - Treat reversible causes
    - Go to 5 or 7
    - If no signs of return of spontaneous circulation (ROSC), go to 10 or 11
    - If ROSC, go to Post-Cardiac Arrest Care

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Follow-up Resources

Useful Web Links:


