Hypothermia, Induced: Caring for the Patient with

What Is Induced Hypothermia?

➢ To induce hypothermia is to intentionally lower the patient’s body temperature below the normal range. Therapeutic hypothermia has been shown to be neuroprotective and to reduce mortality in victims of cardiac arrest

- *What:* Therapeutic hypothermia, when initiated within no more than 6 hours following resuscitation, is an established means of protecting neurologic functioning in adult patients who are successfully resuscitated following cardiac arrest. Guidelines on resuscitation including therapeutic hypothermia have been published by the American Heart Association (AHA), International Liaison Committee on Resuscitation, and the European Resuscitation Council

- *How:* Therapeutic hypothermia can be induced by applying external cooling by way of ice packs to the patient’s axillae, groin, and neck and by applying internal cooling by infusing cooled IV solution. If available, a hypothermia cooling blanket can be used in lieu of ice packs. The goal is to lower the patient’s core temperature to between 89.6–96.8 °F (32–36 °C) for a minimum of 24 hours. The patient requiring therapeutic hypothermia is in a comatose state, and it is necessary to keep the patient intubated and administer sedation and a continuous neuromuscular blockade to depress the shivering reflex triggered by the posterior hypothalamus in an attempt to raise body temperature

- *Where:* Therapeutic hypothermia is used in EDs, ICUs and in the pre-hospital setting

- *Who:* Physicians, nurses, paramedics, physician assistants, and other licensed clinicians may participate in care of the patient undergoing induced hypothermia

What Is the Desired Outcome of Induced Hypothermia?

➢ The primary desired outcome of induced therapeutic hypothermia is to maintain adequate neurologic functioning in patients who have experienced cardiac arrest

Why Is Induced Hypothermia Important?

➢ Cardiac arrest interrupts circulation of blood to vital organs, including the brain, which leads to brain ischemia and injury within minutes. Although the precise physiologic mechanism remains unclear, it is believed that hypothermia provides neuroprotection by offering protection from further reperfusion injury and reoxygenation injury, and by reducing cerebral metabolic rate and oxygen requirements

Facts and Figures

➢ Investigators who conducted a secondary analysis of a multicenter trial involving 16,875 patients with out-of-hospital cardiac arrest found that therapeutic hypothermia was independently associated with improved survival and functional recovery. Other factors that were independently associated with a favorable outcome were early coronary angiography and coronary reperfusion (Callaway et al., 2014)

➢ In a retrospective review from 2003–2016, including 225 patients receiving extracorporeal life support and kept at either a normal or hypothermic temperature, researchers found that 26.6% of hypothermic patients survived neurologically intact compared with 20.3% of normothermic patients (Pand et al., 2017)
What You Need to Know Before Caring for the Patient Undergoing Induced Hypothermia

› Understanding of the physiologic benefits of therapeutic hypothermia on neurologic functioning (see What Is Induced Hypothermia? and Why is Induced Hypothermia Important?, above)

› Clinicians who assist with induction of hypothermia should be familiar with current AHA Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care and facility/unit protocol for responding to cardiopulmonary arrest (For details, see the series of Nursing Practice & Skill papers on CPR)

• Most published recommendations for therapeutic hypothermia stipulate that the recipient
  – be an adult (at least 18 years of age or older)
  – be resuscitated from cardiac arrest
  – be intubated and mechanically ventilated
  – be hemodynamically stable with or without vasopressors
  – be without intracranial injury
  – have a Glasgow coma score < 8

• Contraindications to therapeutic hypothermia include the following:
  – Do not resuscitate (DNR) or do not intubate orders
  – Interval between collapse and resuscitation > 60 minutes
  – Coma prior to cardiac arrest
  – Sepsis or multiorgan failure
  – Refractory hypotension
  – Severe coagulopathy
  – Extensive trauma
  – Recent major surgery (intracranial, intrathoracic, intraabdominal)

› Knowledge of normal core body temperature and the importance of temperature monitoring in the patient undergoing induced hypothermia is important

• Core body temperature is the temperature of the body’s organs, versus the temperature of the peripheral tissues. Core body temperature in a normal adult averages about 98.6 °F (37.0 °C). Older adults often have slightly lower temperature ranging from 95–97 °F (35–36.1 °C). In a child, normal temperature ranges from 97–100.4 °F (36.1–38°C)

• It is essential to monitor temperature in the patient undergoing induced hypothermia. This is best accomplished using continuous core temperature monitoring equipment (nasopharyngeal, bladder, or rectal monitor) or by assessing temperature on a frequent (e.g., 15 minute) basis

• The goal is to induce “mild” hypothermia in the range of 89.6–96.8°F(32–36 °C) for a minimum of 24 hours. Although definitions vary depending on the reference used, “moderate” hypothermia can be described as core temperature between 86–89 °F (30–32 °C) and “severe” hypothermia as < 86 °F (< 30 °C). It is important not to cool below 89 °F (32 °C) to limit the risk of complications. Lowering core temperature below 86 °F (30 °C) can be life-threatening

› Familiarity with medications administered to patients undergoing induced hypothermia and knowledge of safe medication administration is important

• The body responds when core body temperature drops below 90 °F (32.2 °C) by shivering, which produces heat through muscular contractions, peripheral vasoconstriction, which reduces heat loss, and raising the basal metabolic rate. To maintain body temperature in the mild hypothermic range, it is often necessary to prevent shivering by administering a neuromuscular blocking agent and sedative

• The clinician should demonstrate competence in medication administration, including verification of the 6 “rights of medication administration to reduce errors: right patient, right drug, right dose, right route, right time, and right documentation following administration”
  – Understand further rights to be considered are right to refuse, right to be educated, right reason, and right response

› Competence in continuous cardiopulmonary monitoring and mechanical ventilation is essential

• Lowering the core body temperature can impair the cardiac conduction system leading to bradyarrhythmias, and the patient who has experienced cardiac arrest is at risk for a second cardiac arrest. For more information on this topic, see Nursing Practice & Skill ... Telemetry Monitoring

• The patient undergoing induced hypothermia is sedated, intubated and mechanically ventilated so the clinician must possess knowledge of oxygen therapy, monitoring oxygenation (e.g., oxygen saturation/ABG testing), and mechanical ventilation. For more information on this topic, see series Nursing Practice & Skill papers on mechanical ventilation
Complications of therapeutic hypothermia are minimized when temperature is maintained within the mildly hypothermic range, but the following complications can potentially occur:

- **Arrhythmias.** As discussed above, hypothermia increases risk of bradycardia and conduction disturbances
- **Impaired coagulation/increased risk for bleeding due to reduced enzymatic rates and reduced platelet function**
- **Hypoperfusion to skin secondary to diminished cardiac output and peripheral vasoconstriction.** Diminished blood flow to the skin and subcutaneous tissues can lead to pressure ulcers
- **Hyperglycemia secondary to decreased insulin release and insulin sensitivity**
- **Electrolyte abnormalities due to increased release of electrolytes by the kidneys, intracellular shift, and diuresis**
- **Infection (e.g., pneumonia) due to impaired immune function, inhibited inflammatory responses, and diminished gastrointestinal motility**
- **Shivering** which results in significant increases to oxygen consumption and increased risk for hypoxia
- **In patients with a history of coronary artery disease, hypothermia can cause coronary vasoconstriction and increased risk of myocardial infarction (MI)**
- **Upon rewarming, hypovolemia and hypotension can occur due to blood vessel vasodilation**
- **If the patient is rewarmed too quickly (> 0.5 °C per hour), rebound pyrexia (fever) can occur**

Preliminary steps that must be performed prior to caring for the patient undergoing induced hypothermia include the following

- Review facility/unit specific protocol for administering CPR and responding to a cardiopulmonary arrest, and protocol for administering therapeutic hypothermia, if available
- Review the treating clinician’s order for induced hypothermia
- Note the frequency with which the temperature should be taken and prescribed actions to adjust core body temperature (e.g., administer sedative, apply cooling blanket)
- Verify completion of facility informed consent documents, if appropriate. If induced hypothermia is performed under emergent conditions, the universally accepted standards of care offer implied consent
- Review the patient’s medical records for
  - any allergies (e.g., to latex, medications, or other substances); use alternative materials, as appropriate
  - history of present illness (e.g., trauma, MI)
  - contraindications to induced hypothermia (e.g., severe coagulopathic condition, coma prior to arrest, presence of a DNR order)
  - current medications and medication orders specific to induced hypothermia

Gather the necessary supplies and equipment, which can include:

- Nonsterile gloves and other personal protective equipment (PPE, e.g., gown, mask) depending on anticipated exposure to blood and body fluids
- 3-6 liter bag of cooled (refrigerated to 39.2 °F [4 °C]) Lactated Ringer’s solution
- IV infusion tubing, infusion pump, and IV stand
- Ice contained in plastic bags
- Hypothermia cooling blanket, if available
- Vital sign monitoring equipment, including equipment for continuous pulse oximetry (SpO₂) and capnography (EtCO₂); utilize continuous temperature monitor when available
- Prescribed medications prepared for administration
- Continuous cardiac monitoring equipment
- Mechanical ventilator and oxygen source
- Equipment for resuscitation including
  - **Emergency resuscitation cart (“crash cart”)**
  - Manual defibrillator or AED
  - Backboard or other hard surface
  - Airway supplies (e.g., bag valve mask, endotracheal tubes in various sizes, suction equipment)
  - Supplemental oxygen cylinder and flowmeter
  - Emergency medications (e.g., epinephrine, vasopressin) and supplies for administering medications

**How to Care for the Patient Undergoing Induced Hypothermia**

- Perform hand hygiene and don PPE; these hygiene measures may not be possible in the case of emergency because doing so may result in a loss of valuable resuscitation time
Identify the patient according to facility protocol

Establish privacy by closing the door to the patient’s room and/or drawing the curtain surrounding the patient’s bed

Although induced hypothermia is performed in an unconscious patient, it is appropriate, if family members are present and time permits, to briefly explain the purpose of the procedure even after it is completed. Introduce yourself to the family member(s), if present; explain your clinical role; assess the coping ability of the family and for knowledge deficits and anxiety regarding the procedure and the need for induced hypothermia

- Determine if the family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, or deafness); make arrangements to meet these needs if they are present
  - Use professional certified medical interpreters, either in person or via phone, when language barriers exist
- Explain the procedure and its purpose; answer any questions and provide emotional support as needed. Reassure the family that the patient’s comfort level and level of sedation will be closely monitored

As appropriate, ask family members and other visitors to leave the patient’s room in order to clear the area for intensive patient care procedures

Provide advanced life support management, as needed

- Assist with intubation, if not already done, and mechanical ventilator set-up and attachment
- Assist with/verify attachment to cardiac monitor. If available, set-up continuous temperature monitoring device
- Establish IV access if not already done and attach to hanging IV fluids
- Assess physiologic status including neurologic status, cardiopulmonary status, and hemodynamic condition
- Evaluate and document temperature and other vital signs together with EKG, SpO2 and EtCO2

Cool patient by infusing 30 ml/kg of refrigerated Lactated Ringer’s solution over 30 minutes—monitoring for fluid overload—and by applying ice packs to the patient’s groin, axillae, and neck. If available, a hypothermia cooling blanket can be applied instead of using ice packs

Monitor temperature; once temperature of 89.6–96.8 °F (32–36 °C) is reached, remove external cooling device (ice packs/blanket) to maintain temperature for a minimum of 24 hours. If temperature rises during this time, reapply external cooling device

Adhering to safe medication practices (reviewing the “6 rights”), administer neuromuscular blocking agent to prevent shivering. Administer sedation according to facility protocol

Monitor for complications (see Red Flags, below) while therapeutic hypothermia is maintained

After hypothermia has been maintained for the prescribed duration of time, permit passive rewarming to occur by removing external cooling device

Continue to monitor the patient’s temperature on an ongoing basis until temperature rises to normal range, being aware to rewarm no more than 0.5 °C per hour

Discard used supplies and PPE and perform hand hygiene

Update the patient's plan of care, as appropriate and document the following in the patient's medical record

- Time and date hypothermia was induced, including
  - indication for therapeutic hypothermia/history of current illness
  - details of physical assessment, including temperature, neurologic, pulmonary, and hemodynamic status throughout the procedure
  - method of cooling
  - medications that were administered, dosages, and route of administration
- Any unexpected events that occurred, interventions performed, and whether or not the treating clinician was notified
- Patient/family member education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That May Be Necessary Before or After Procedure

- It may be necessary to replace ice packs or infuse additional cooled IV solution if the patient’s temperature remains elevated above the therapeutic range

What to Expect After Procedure

Therapeutic hypothermia is achieved, the patient’s neurologic functioning is protected from further injury, and following treatment the patient passively returns to normal body temperature
Red Flags
› Before initiating resuscitative efforts in the healthcare setting, quickly check for a DNR armband that designates modifications to their code status
› Patients who experience cardiopulmonary arrest remain at risk for second cardiopulmonary arrest
› Severe hypothermia can result in severe bradycardic arrhythmias, ventricular fibrillation, and death
› Therapeutic hypothermia has been associated with development of pressure ulcers, coagulopathy, infection, paralytic ileus, rebound pyrexia, hypovolemia and hypotension upon rewarming

What Do I Need to Tell the Patient/Patient’s Family?
› Explain the indications for resuscitation measures, including induced hypothermia, to family members
› Inform the family of their right to be involved in the decision-making process
› Consult with and discuss with the patient and family about whether or not to initiate resuscitation if the patient experiences cardiopulmonary arrest again
› Assist the patient and family with completion of DNR orders, if they desire

References