UNIVERSITY of MARYLAND MEDICAL CENTER	HOSPITAL CLINICAL GUIDELINES	PAGE: 1 OF 5	GUIDELINE NO: SPP-015
		EFFECTIVE DATE: 09/07	LAST REVISION DATE: 09/14
SUBJECT: USE OF HYPOTHERMIA FOLLOWING CARDIAC ARREST		FUNCTION: SPECIALTY POPULATIONS	

KEY WORDS: Hypothermia, Cardiac Arrest

I. GUIDELINE

A. OBJECTIVES

To provide guidelines for use of targeted temperature management following cardiac arrest to improve neurological outcomes in patients after cardiac arrest and to reduce complications related to reperfusion injury.

B. INDICATION FOR USE

Patients at UMMC who survive cardiac arrest who meet established criteria.

C. DEFINITIONS

None

II. RESPONSIBILITY

Provider	Evaluate patient status and place order for patient to begin hypothermia protocol if indicated using Hypothermia Protocol Powerplan/Orderset
RN Responsibilities	Call SOSC to request equipment & supplies (See Attachment A) to implement protocol Provide medications as ordered, monitoring and ongoing care to cool and rewarm patient per standards.
Materials Distribution Center	Deliver all necessary equipment and supplies to unit where patient is located within 15 minutes of call from SOSC

III. GUIDELINES

A. RECOMMENDED INCLUSION CRITERIA

1. Hypothermia should be initiated within 6 hours of cardiac arrest
2. Sustained cardiac arrest related to ventricular tachycardia, ventricular fibrillation, pulseless electrical activity, or asystole
3. Restoration of circulation within a time the attending physician determines provides adequate for a chance for sustainable recovery
4. Patient unable to follow commands (determined after return of spontaneous circulation)
5. Hemodynamically stable (e.g., systolic BP > 85 mmHg or MABP > 55 mmHg) with or without vasoactive agents or circulatory support
6. Patient must have a protected airway and be on mechanical ventilatory support

B. RECOMMENDED EXCLUSION CRITERIA

1. Existing advanced directives precluding resuscitation or hypothermia
2. Hemodynamically unstable (see above)
3. Pre-arrest significant neurologic injury or GCS score pre-arrest < 5
4. Greater than 6 hours following arrest
5. Relative contraindications include:
    a) Active bleeding
    b) Sepsis
6. Patient weight less than 65 pounds NOTE: Arctic Sun devices at UMMC are NOT configured for use in any patient less than 65 pounds – Device CANNOT be used in patients under 65 pounds.

C. PRIOR TO INITIATION OF HYPOTHERMIA MANAGEMENT

1. Obtain the following baseline studies as soon as possible but obtaining these studies should not delay cooling:
    a) Arterial blood gas
        i. Include patient's temperature on the lab requisition for lab to temperature correct the ABGs.
    b) Complete blood count
    c) Chemistry panel
    d) Lactate level
    e) Cardiac enzymes
    f) Coagulation parameters
    g) Liver function tests
    h) Chest radiograph
    i) 12-lead Electrocardiogram
2. Contact Support Operation Service Center (SOSC) @ 8-5174 to request all needed equipment and supplies (see

Attachment A) "Please send equipment for a patient requiring hypothermia following cardiac arrest to…".
   a) Equipment distribution will deliver all equipment including the disposables within 15 minutes.
3. Obtain cold saline from pharmacy or unit medication refrigerator
4. Insert one of the following continuous core body temperature monitoring devices:
   a) If in situ, use pulmonary artery catheter temperature measurements.
   b) A bladder temperature may be obtained using a temperature sensing bladder catheter.
   c) If gastric lavage is not in use an esophageal temperature may be used.
   d) A rectal probe should be used to measure temperature only if other options are unavailable.
5. If appropriate, use a heat moisture exchanger (HME) for patient humidification
6. An arterial line and central venous catheter should be placed during induction
   a) Continuous SvO2 or ScvO2 monitor may be desirable.
      i. Significant decreases in SvO2 may occur with hypothermia especially if neuromuscular blockade is inadequate.

D. RECOMMENDED SEDATION AND ANALGESIA DURING HYPOTHERMIA

1. Administer sedative, analgesia and anti-shivering interventions **as ordered by provider**
   (NOTE: No one agent has been proven most effective for use during hypothermia following cardiac arrest):
   a) Recommended Sedation:
      i. Propofol (Diprivan®): 10 mcg/kg/min and then if needed may titrate up every 5 minutes not to exceed a dose > 30 mcg/kg/min if patient's GCS is > 8 (If a dose above 30 mcg/kg/min is needed to provide sedation a physician should be consulted.) and/or
      ii. Dexmedetomidine (Precedex®): Initiate continuous infusion of 0.2 mcg/kg/hr IV titrated to heart rate < 100 bpm and shivering controlled;
      Hold if heart rate < 70 bpm. (NOTE: May not see effect right away; Titration should not be done more often than every 20 minutes)
   b) Recommended Analgesia:
      i. Fentanyl (Sublimaze®): 50-100 mcg IV bolus x 1, then
      ii. Fentanyl (Sublimaze®): 25-200 mcg/hr (initially at 50 mcg/hr) continuous infusion

E. INITIATION OF HYPOTHERMIA

1. Lower patient's body temperature to 32 – 34°C as quickly as possible using the following methods as needed in the order listed
   a) If the patient becomes unstable during cooling, temperature management targeted at 36°C can be considered.
   b) Consider a bolus of a paralytic on induction to assist with lowering the patient's temperature quickly.
   c) Intravenous administration of 2 liters of iced cold fluid as a bolus.
      i. Bags of cold saline can procured from refrigerators in Pharmacy's throughout UMMC, in some unit medication refrigerators and in TRU blood bank refrigerators.
      ii. Proceed to other techniques if patient volume overloaded and additional fluid administration is contraindicated.
   d) Surface cooling techniques may be used in tandem with other strategies to cool the patient
      i. Cooling blankets (Set the cooling blanket on automatic with the temperature at 33°C).
         (a) Contact SOSC and request "Hypothermia following cardiac arrest" and stipulate the size disposable needed (**see Attachment A**: Supplies Used for Hypothermia).
         (b) Three Arctic Sun devices and disposables are kept in Equipment Distribution for post-arrest hypothermia. If the three Arctic Sun devices from Equipment Distribution are in use, the Arctic Sun device housed in Neurocare ICU may be requested.
         (c) If no Arctic Sun device is available, the Gaymar 7900 cooling blanket can be used and those are also available from Equipment Distribution.
            (i) Two cables and a chest wrap and 2 thigh pads are used to cool the patient with the Gaymar 7900 machine.
            (ii) If unable to obtain the vest and thigh pads for the Gaymar 7900 use 2 cooling blankets– one wrapped around the torso and the other around the thighs.
      ii. Ice packs may be used around the head, axillary and femoral areas for initial cooling.
   e) Invasive cooling measures may be considered in patients who fail to achieve the desired temperature reduction.

i. Endovascular cooling device
ii. Continuous renal replacement therapy

F. MAINTENANCE OF HYPOTHERMIA AND PATIENT MONITORING

1. Maintain hypothermia for 24 hours from the time the patient reaches goal temperature.
   a) If a patient comes from an outlying facility where cooling was initiated and is > 36°C consider the 24 hour cooling period to begin once active cooling is initiated at UMMC.
2. During and for at least 48 hours after hypothermia vital signs should be monitored continuously and recorded at least every 1 hour.
3. Water temperature in the cooling device should also be recorded hourly with the patient's temperature to determine if the cooling device has to lower the water temperature to maintain hypothermia thereby suggesting the patient may be mounting a fever or shivering.
4. Assess shivering and document hourly
   a) Place hands over the patient's neck and upper thorax. The severity of shivering should be recorded using the Bedside Shivering Assessment Scale below:

BEDSIDE SHIVERING ASSESSMENT SCALE (Badjatia, N, et al. Stroke, Dec. 2008: 3242)

Score	Definition
0	None: no shivering noted on palpation of the masseter, neck or chest wall
1	Mild: shivering localized to the neck and/or thorax only
2	Moderate: shivering involves gross movement of the upper extremities in addition to the neck and thorax
3	Shivering involves gross movements of the trunk and upper and lower extremities

5. Anti-shivering interventions are recommended to maintain a Bedside Shivering Assessment Scale Score less than or equal to 1.
   a) Recommendations for management of shivering:
      i. Use the Bair hugger blanket set at the maximal temperature to provide warm air flow to the patient's hands and face for skin counter warming
      ii. Consider Buspar 30 mg po or per NGT every 8 hours (In combination with Meperidine, (Demerol®) or Dexmedetomidine (Precedex®) buspar has a synergistic effect.)
      iii. Consider Neuromuscular blocking agent (NMBA): Prior to initiation verify that the patient is adequately medicated with analgesic and sedative agents at goal and is receiving mechanical ventilation.
         (a) Vecuronium 0.1 mg/kg IV intermittent bolus dosing
         (b) Readminister bolus every 1 hour until patient's temperature is less than 34oC and patient not shivering.
         (c) If you see breakthrough shivering rebolus the neuromuscular blocking agent.
         (d) Bolus intermittent dosing PREFERRED to continuous infusions of neuromuscular blocking agents but if shivering continues or reoccurs or if SvO2 or ScvO2 is low (< 60%) initiate continuous infusion of neuromuscular blocking agent: Cisatracurium (Nimbex®): 0.15-0.2 mg/kg IV bolus x 1, then Cisatracurium (Nimbex®): 1-2 mcg/kg/min continuous infusion to obtain 1 -2 twitches on the hourly train of four assessment.
      iv. If indicated, consider Meperidine (Demerol®) 50 mg IV every 4 hours as needed for shivering (Absolutely contraindicated for patients on MAO inhibitors within the previous 14 days)
6. Maintain normocarbia (35-45 mm Hg for patients without significant baseline hypercapnia).
   a) Exhaled CO_2 may be used as a continuous measurement to guide titration of ventilation.
   b) Elevated exhaled end-tidal CO_2 ($ETCO_2 \geq 45$ mm Hg) should warrant efforts to increase CO_2 removal.
   c) Low exhaled $ETCO_2$ (≤ 30 mm Hg) may require ventilation changes when low PaCO2 is also suspected and as long as the relationship to $PaCO_2$ is quantified and believed to be stable (no dynamic, dramatic changes in hemodynamic support requirements or lung injury and/or pulmonary edema.
   d) For patients with severe chronic hypercapnea who have a cardiac arrest, (e.g. severe COPD with elevated baseline serum HCO_3^-), deviations from the above ventilation goals may be necessary to avoid severe, post-hypercapnic metabolic alkalosis.
7. Continuously monitor SpO_2 (Goal SpO_2 = 94 – 98 %; AHA recommends providing inspired oxygen to the lowest

level required to achieve an arterial oxygen saturation of ≥ 94%) and, if available, $ScvO_2/SvO_2$

8. Maintain mean arterial blood pressure (MABP) > 80 mmHg
    a) Ensure patient is euvolemic
    b) Once euvolemia is ensured, if patient's MABP remains inadequate consider use of a vasoactive or inotropic agent.
        i. No one agent has been proven most effective but Norepinephrine is suggested as initial drug.
9. Every 6 hours obtain the following laboratory studies during therapeutic hypothermia and for 24 hours after rewarming begins:
    a) Arterial blood gases (temperature corrected)
    b) Chemistry panel
10. Provide continuous EEG monitoring during hypothermia and rewarming.

G. REWARMING GUIDELINES

a) After 24 hours of cooling, gradually rewarm the patient at a rate of ≤ 0.2 °C every hour.
b) If in use, maintain sedation and paralytic, until temperature of 36°C is reached. First discontinue the paralytics and then the sedation after a train of four of 4 is achieved. If the patient's neurologic assessment remains a concern due to paralysis, consider administering a reversal agent.
c) Monitor patient during re-warming for:
    i. Hypotension related to vasodilation associated with rewarming. Hypothermia induces vasoconstriction that when rewarming occurs may result in a functional hypovolemia that may require fluid administration.
    ii. Hyperkalemia
    iii. Increased $paCO_2$ due to increasing metabolic rate
    iv. Shivering, particularly as patient's temperature ascends from 33.5 – 35.5°C when shivering is most likely. If not on interventions to prevent shivering, then consider use of anti-shivering interventions during re-warming to prevent warming the patient too quickly.
    v. Increased insulin sensitivity
    vi. Increased rate of clearance of certain drugs

2. Once the patient reaches a core body temperature of 37 °C maintain the patient's temperature at ≤ 37 °C for the next 48 hours.
3. If possible, minimize sedation (goal RASS 0 - +1)
4. Complete the Therapeutic Hypothermia Tracking Tool (**See Attachment B**) and submit to your manager to forward to Karen McQuillan for entry into an UMMC hypothermia database.
5. Early prognostication before 72 hours after return of spontaneous circulation is not advised.

IV. REPORTABLE CONDITIONS

A. Hypotension related to vasodilation associated with rewarming.
B. Hyperkalemia
C. Increased paCO2 due to increasing metabolic rate
D. Shivering, particularly as patient's temperature ascends from 33.5 – 35.5oC when shivering is most likely.
E. Increased insulin sensitivity
F. Increased rate of clearance of certain drugs

V. DOCUMENTATION

A. All patient assessments, medications and clinical data will be documented in the patient's medical record.
B. Complete the Therapeutic Hypothermia Tracking Tool (See **Attachment B**)

VI. SUPPORTIVE INFORMATION

A. SEE ALSO

1. **Attachment A**: Supplies Used for Hypothermia
2. **Attachment B**: Therapeutic Hypothermia Tracking Tool
3. **Attachment C:** Management of Shivering

B. REFERENCES

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C. COMMUNICATION AND EDUCATION

1. This policy will be communicated to the appropriate UMMC personnel via the following channels:
   a) The policy will be placed in the Clinical Practice Manual on the UMMC Intranet; and
   b) Education will be communicated via Nursing and other departmental staff meetings and publications as necessary.

DEVELOPER(S) Hypothermia Taskforce

REVIEWED/REVISED: 09/07, 07/10, 6/13, 10/13, 9/14