INTRODUCTION

Fever in brain-injured patients is associated with increased morbidity and mortality. Maintaining normal patient temperature (normothermia) in the absence of infection or sepsis syndrome can be accomplished safely using both non-invasive (external) cooling devices and invasive catheter-based cooling devices (internal).

SCOPE

All Registered Nurses (RNs) working in the Adult Intensive Care Units (ICUs).

PURPOSE

To provide a collaborative and interdisciplinary protocol to maintain normothermia in brain-injured patients with fever refractory to conservative treatment by using external surface cooling or internal catheter-based cooling methods.

A. Patient Inclusion:

1. Presence of fever (T > 101.5°F / T > 38.6°C) that is refractory to conservative measures, including: acetaminophen and ice packs within 2 hours of fever onset.

   a. Refractory indicates.
      - Failure to reduce fever below 100.5°F (38°C), or
      - Recurrence of temperature > 100.5°F within four hours of initiation of conservative measures.

   b. Patient must have undergone appropriate infectious disease work-up for fever source and initiation of anti-microbial therapy if indicated.

B. Contraindications:

1. Diagnosis of sepsis syndrome.

2. Active cardiac dysrhythmia with hemodynamic instability.

3. Contraindications to induced temperature reduction:

   a. Known hematological dyscrasias which affect thrombosis (cryoglobulinemia, sickle-cell disease, serum cold agglutinins).

4. For external surface cooling methods:

   a. Preexisting skin condition that excludes the use of cooling pads (Non-Invasive Cooling).

5. For internal catheter-based cooling methods:

   a. Previously placed inferior vena cava (IVC) filter.
b. Contraindication for central venous catheter placement.
c. Known or suspected diagnosis of heparin induced thrombocytopenia (HIT).
d. Relative Contraindication: ipsilateral deep vein thrombosis (DVT) - may consider placement on contralateral side.

C. Risk Factors:

1. Device-Related:
   a. For external surface cooling methods:
      ● Potential skin breakdown from contact with cooling surface. Patients will be turned and positioned per standard and as tolerated. Skin assessments will occur with routine patients assessment.
   b. For internal catheter-based cooling methods:
      ● Risk factors associated with central line insertion and maintenance.
      ● Potential cardiac arrhythmia during insertion of internal cooling catheter.

PROCEDURE

A. Provide Patient and Family Education and Support.

1. Explain the purpose of normothermia in the brain-injured patient.
2. Encourage the family to continue to talk to the patient and to participate in care when appropriate (ROM, turning, skin care, and mouth care).
3. Provide emotional support and answer any questions. Offer pastoral care support to the family.
4. Facilitate communication between the family and the physician/Nurse Practitioner (NP)/Physician Assistant (PA).

B. Initiating Treatment:

1. Patient preparation.
   a. RNs will identify all patients with refractory fever.
   b. Attending Physician or designee will decide on the most appropriate cooling modality; place either external surface pads or a central venous accessed cooling catheter.
   c. A rectal temperature probe will be placed for continuous temperature monitoring in patients needing MRI.
   d. A bladder temperature probe may be used in patients NOT needing MRI (foley probe is not MRI compatible).
   e. Target temperature for normothermia will be set at 98.6°F (37°C).
   f. Ventilator warming device temperature will be maintained at ≤ 98.6°F (37°C).
   g. Baseline cultures will be sent to detect infection prior to institution of cooling therapy. These include:
      ● Blood
      ● Urine
● Sputum
● Cerebral spinal fluid (CSF) (if applicable)

h. Either external surface pads will be placed by RN or a central venous cooling catheter will be placed by the physician/NP.

C. Patient Management.

1. Normothermia will be maintained continuously for up to 72 hours with either a non-invasive or invasive cooling device at which time the need for ongoing temperature control will be reassessed.

2. Should the patient subsequently develop a refractory fever over the next 24 hours, re-induction of normothermia will be considered at the discretion of the ICU Physician team.

3. Review anti-epileptic regimen in neurological patients. Change therapy to Keppra® as directed by ICU Physician team/Neuro-Critical Care team if patient is currently taking phenytoin or phenobarbitol. Phenytoin and phenobarbitol are theorized to promote the breakdown of meperidine to normeperidine potentially lowering the seizure threshold.

4. Administer acetominophen per prescriber’s order.

5. White blood count (WBC) will be followed daily during the period of induced normothermia. A rise in the WBC by 20% from the time of initiation of induced normothermia is considered significant and will prompt an infection workup.

6. Additional cultures will be sent every 72 hours if an infectious source is suspected but not identified. The need for additional cultures prior to 72 hours is left to the discretion of the treating intensivist.

7. Monitor body temperature and machine water bath temperature every 2 hours.
   a. Monitoring device water bath temperature may indicate when patient is experiencing fever. If the water bath temperature decreases and remains low the machine is cooling signaling the patient is generating heat. Clinical exam during this period may indicate a need for an infection workup.

8. Physiologic assessment will include (if present and applicable):
   a. Heart Rate (HR) every 2 hours.
   b. Mean Arterial Pressure (MAP) every 2 hours.
   c. Brain Tissue Oxygen Tension (PbtO2).
   d. Jugular Venous Oxygen Saturation (SjvO2).
   e. Oxygen Saturation (SaO2).
   f. Intracranial Pressure (ICP).
   g. Cerebral Perfusion Pressure (CPP).

D. Shivering Management: Shivering may be encountered while maintaining normothermia. The following protocol will be instituted as follows:

1. Non-pharmacologic measures: To be used before administering medications.
a. Bair Hugger applied to exposed skin.
b. Hand-warming instant hot packs x 1 hour.

2. Pharmacologic measures per prescriber’s orders: *(Refer to UPHS Formulary)*
   a. Buspirone Hydrochloride
   b. Meperidine:
      
      1.) **Contraindications:**
         a.) Not to be used in patients with documented renal insufficiency defined as a Creatine Clearance (Cr Clear) < 50ml/min.
         b.) Cockcroft-Gault Creatine Clearance:
            - Male: 140 – (Age) [Wt /Cr mg/dl x 72]
            - Female: 140 – (Age) [Wt /Cr mg/dl x 72] x 0.85
         c.) Not to be use with concomitant use of Monoamine oxidase (MAO) Inhibitors (within 2 weeks).

      2.) **Discontinuation:**
         a.) Evidence of seizure activity via electroencephalogram (EEG) or clinical exam.
         b.) Maximum cumulative dose – 300mg.

c. Clonidine: Only appropriate patients (Hypertension).
d. Continuous infusion sedative-hypnotic agents (propofol, fentanyl) only appropriate patients (Ventilator-dependent).
e. **Consider Paralytics/neuromuscular blockade only as last resort.**

   a. Assess patient every 2 hours for evidence of shivering/rigors/chills using both tactile and visual assessment according to the Holtzclaw shivering scale.
      - Holtzclaw Shivering Scale:
         0 = no visible or palpable shivering
         1 = palpable mandible vibration or EKG artifact
         2 = visible fasiculations of the head or neck
         3 = visible fasiculations of the pectoris and trunk
         4 = generalized shaking of the entire body and teeth chattering

   b. Daily assessments of shivering events will include:
      - Incidents of shivering.
      - Methods to induce cessation of shivering.
      - Time to cessation.
      - Breakthrough events.

   c. Daily total dose of buspirone will be recorded on the flowsheet and cumulative amount recorded at 0600.
   d. Daily total dose of meperidine (Demerol) will be recorded on flowsheet noting 24 hour total and cumulative 3 day total recorded at 0600.
DOCUMENTATION

A. Nursing Flowsheet.

1. Physiologic data if applicable:
   b. HR.
   c. MAP.
   d. PbtO2.
   e. SjvO2.
   f. SaO2.
   g. ICP.
   h. CPP.

2. Body and water bath temperature.

3. Shivering management.
   a. Patient Shivering Score.
   b. Incidents of shivering.
   c. Methods to induce cessation of shivering.
   d. Time to cessation.
   e. Breakthrough events.
   f. Daily total dose of buspirone and cumulative 24 hour total recorded at 0600.
   g. Daily total dose of meperidine and cumulative 24 hour total and cumulative 3 day total recorded at 0600.

REFERENCES


Supersedes: New
Effective Date: December 28, 2007
Appendix A: Normothermia Tipsheet

Goals: Induce normothermia in brain-injured patients with fever refractory to conservative treatment by using external surface cooling or catheter-based cooling methods.

Patient Eligibility:
1. Presence of fever (T > 101.5°F / T > 38.6°C) that is refractory to conservative measures, including:
   a. Acetaminophen 650mg, cooling blankets, and ice packs within 2 hours of fever onset.
   b. Refractory indicates failure to reduce fever below 100.5°F (38°C), or recurrence of temperature > 100.5°F within four hours of initiation of conservative measures.

2. Patient must have undergone appropriate infectious disease work-up for fever source and initiation of anti-microbial therapy if indicated.

Exclusion Criteria:
1. Contraindications to induced temperature reduction: cryoglobulinemia, sickle-cell disease, serum cold agglutinins.
2. Diagnosis of sepsis syndrome.
3. Active cardiac dysrhythmia with hemodynamic instability.
4. Preexisting skin condition that precludes the use of adhesive cooling pads.

Procedure:
1. The RN will identify all patients with refractory fever. The Attending Physician or designee will decide on the most appropriate cooling modality.
   a. Place a rectal temperature probe in patients needing MRI. Do not use bladder temperature probe in patients needing MRI (foley probe is not compatible with MRI).
   b. Place either external surface pads or a central venous accessed cooling catheter-based cooling.
   c. Target temperature for normothermia will be set at 97.7°F-99.5°F (36.5°C – 37.5°C).
   d. Maintain ventilator warming device temperature at < 98.6°F (37°C).
   e. Administer 650 mg tylenol every 4 hours x 72 hours.
   f. Document body and water bath temperature with each recording of vital signs (every 2 hours or more frequently based on patient acuity).

2. Baseline cultures: blood, urine, sputum, and CSF (if applicable) will be sent to detect infection at institution of cooling therapy.
   a. Follow WBC daily during the period of induced normothermia. A rise in the WBC by 20% from the time of initiation of induced normothermia is considered significant and will prompt an infection workup.
   b. Send additional cultures every 72 hours if an infectious source is suspected but not identified. The need for additional cultures prior to 72 hours is left to the discretion of the treating intensivist.

3. Maintain normothermia continuously for up to 72 hours, at which time the need for ongoing temperature control will be reassessed. Should the patient subsequently develop a refractory fever over the next 24 hours, re-induction of normothermia will be considered and left to the discretion of the Critical Care/Neuro-Critical Care team.

4. Review anti-epileptic regimen. Change therapy to Keppra (500 to 1500 mg every 12 hours) as directed by Critical Care/ Neuro-Critical Care team, if patient is currently taking phenytoin or...
phenobarb. Phenytoin and phenobarb are theorized to promote the breakdown of meperidine to normaperidine, potentially lowering the seizure threshold.

5. Shivering may be encountered while maintaining normothermia. The Shivering Management protocol will be instituted as follows:

**Shivering Management Protocol:**

<table>
<thead>
<tr>
<th>Non-Pharmacologic Methods:</th>
<th>Pharmacologic Methods: To be used if non-pharmacologic methods are unsuccessful in reducing shivering.</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be used first</td>
<td></td>
</tr>
<tr>
<td>Bair Hugger applied to exposed skin</td>
<td><strong>Buspirone:</strong> 15-30 mg every 8 hours; <strong>Maximum dose</strong> = 60 mg/day.</td>
</tr>
<tr>
<td>Hand-warming- Instant Hot Packs x 1 hr</td>
<td><strong>Meperidine:</strong> 12.5 mg IV, repeat x 1 in 5 minutes if not effective.\nMay be given every 6 hours. <strong>Maximum dose</strong> = 100 mg/day. <strong>Maximum cumulative dose</strong> = 300 mg.</td>
</tr>
</tbody>
</table>

**Contraindications:**

a.) Not to be used in patients with documented renal insufficiency defined as a Cr Clear < 50ml/min.
b.) Cockcroft-Gault Cr Clearance:\n   ▫ Male: 140 – (Age) [Wt /Cr mg/dl x 72]\n   ▫ Female: 140 – (Age) [Wt /Cr mg/dl x 72] x 0.85
c.) Not to be use with concomitant use of MAO Inhibitors (within 2 weeks).

**Clonidine:** Only appropriate patients (Hypertensive)

**Vented patients:** Continuous infusion sedative-hypnotic agents (diprivan + fentanyl)

**Consider Paralytics only as last resort.**

**Shivering/Rigors/Chills Events:**

1. RN will document every 2 hours on flowsheet evidence of shivering/rigors/chills using both tactile and visual assessment according to the Holtzclaw shivering scale (See Below).
2. Daily documentation of shivering events will include incidents of shivering, methods to induce cessation of shivering, time to cessation, breakthrough events.
3. Documentation of physiologic data will include (if present and applicable): PbtO2, SjvO2, SaO2, ICP, CPP, HR, MAP.
4. Meperidine (Demerol®) dosing will be tabulated daily noting 24 hour and cumulative mg total on flowsheet as well as daily progress note.
5. EEG or clinical evidence of seizure activity: Meperidine dosing will be discontinued.

**Holtzclaw Shivering Scale:**

0 = no visible or palpable shivering
1 = palpable mandible vibration or EKG artifact
2 = visible fasiculations of the head or neck
3 = visible fasiculations of the pectoris and trunk
4 = generalized shaking of the entire body and teeth chattering