## Therapeutic Hypothermia After Cardiac Arrest Protocol

### Purpose
To outline the management of therapeutic hypothermia for the patient following cardiac arrest.

### Level
Interdependent. Requires MD order.

### Supportive Data
Cardiac arrest with widespread cerebral ischemia frequently leads to severe neurological impairment. Mild therapeutic hypothermia (i.e., cooling of cardiac arrest victims to 32-34 degrees Celsius central body temperature for 12-24 hours following out-of-hospital arrest) markedly improves survival rate and neurological outcome. Lowering core temperature to 32-34 degrees Celsius may reduce cell injury by suppressing excitotoxins and oxygen radicals, stabilizing cell membranes and reducing the number of abnormal electrical depolarizations.

### Effects of Therapeutic Hypothermia

| A. | The etiology of anoxic brain injury involves an inflammatory cascade that occurs after restoration of cerebral perfusion. Induction of hypothermia in cardiac arrest survivors is thought to reduce the damage from this inflammatory cascade, as well as reduce cerebral oxygen requirements. |
| B. | Hypothermia activates the sympathetic nervous system causing vasoconstriction and shivering. Shivering increases O2 consumption by 40-100%. Thus, *shivering must be prevented* during hypothermia and is best accomplished by initiating neuromuscular paralysis prior to induction of hypothermia. |
| C. | Hypothermia shifts the oxyhemoglobin curve to the left and may result in decreased O2 delivery. However, the metabolic rate is also lowered, decreasing O2 consumption and carbon dioxide (CO2) production. Ventilator settings may need to be adjusted due to decreased CO2 production, using blood gases. |
| D. | Hypothermia initially causes sinus tachycardia, then bradycardia. |
| 1. | Extremely important to keep temperature >30ºC. |
| 2. | Temperatures: |
| a. | <30º C, increased risk for arrhythmias. |
| b. | <28º C, increased risk for ventricular fibrillation. |
| 3. | Severely hypothermic myocardium (<30ºC) is less responsive to defibrillation and medications. |
| E. | Hypothermia decreases cardiac output and increases systemic vascular resistance (SVR). |
| F. | Hypothermia can induce an in vivo coagulopathy which is not detectable by laboratory testing (as blood is warmed during testing). |
| G. | Hypothermia-induced diuresis is to be expected and should be treated aggressively with fluid and electrolyte repletion. Magnesium, phosphorus and potassium should be monitored closely and maintained in the normal range. |
### THERAPEUTIC HYPOTHERMIA AFTER CARDIAC ARREST PROTOCOL

(because it will rebound to a higher value during rewarming).

H. Decreased insulin secretion and sensitivity leads to hyperglycemia, which should be treated aggressively.

I. Re-warming too rapidly can cause vasodilation, hypotension, and rapid electrolyte shifts.

J. Re-warming is begun 24 hours from the time target temperature is reached.

### PROCEDURE

**Inclusion Criteria:**
1. Patients over 18 years of age
2. Cardiac arrest (VF or pulseless VT) followed by successful return of spontaneous circulation
3. Presumed cardiac origin of arrest
4. Persistent coma at the time of entry into protocol (defined as no eye opening to pain or response to verbal stimulation)
5. Down time < 60 minutes (collapse to return of spontaneous pulse)

**Exclusion Criteria:**
1. Another reason (besides anoxic encephalopathy) to be comatose including drug overdose, head trauma, CVA
2. Pregnancy
3. Cardiogenic shock/persistent (>30 min) hypotension requiring pressors
4. Severe Hypoxemia (SpO2< 85%) >15 min after return of spontaneous pulse
5. A known terminal illness
6. Known, pre-existing coagulopathy
7. Initiation of cooling protocol >1 hour after ED arrive.
8. Recent major surgery within 14 days; systemic infection or sepsis (hypothermia may increase the risk of infection).
9. BMI >40.

**Cooling Phase of Therapy:**
1. Goal temperature of 32-34 degrees Celsius should be started ASAP after arrest and achieved within 4-8 hours.
2. Insert Foley (with temperature probe if available). If patient is oliguric, another internal monitoring device should be placed. E.g. rectal or tympanic.
3. Note time and temperature at onset, and document.
4. Remove clothing.
5. Place ice packs- two on head, two on neck, one in each axilla, one on each femoral artery at groin, until hypothermia blankets are available.
6. Place two cooling blankets: one cooling blanket over the torso of the patient and set at 33 degrees Celsius; one cooling blanket under the torso of the patient and set at 33 degrees Celsius. Place bed sheets above and below the hypothermia blankets next to skin to prevent injury burn when hypothermia machine is available.
7. Turn off the heated humidifier of the ventilator.
8. Turn off heater in room (if applicable).
9. Once blanket reaches 32-34 C [89-93.2F], adjust machine, blanket, or ice packs
### THERAPEUTIC HYPOTHERMIA AFTER CARDIAC ARREST PROTOCOL

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Maintain therapy until core temperature reaches 33 degrees C.</td>
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<tr>
<td>2.</td>
<td>Maintain core temperature at 32-34 degrees C. Provide supplemental cooling as needed to achieve cooling goal (Iced N/G, iced bladder lavage, cold saline via peripheral line and adjusting room temperature).</td>
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<tr>
<td>3.</td>
<td>Assess temperature and skin every 30 minutes and record on “Therapeutic Hypothermia After Cardiac Arrest Nursing Flow Sheet”. Adjust cooling measures accordingly:</td>
</tr>
<tr>
<td>a.</td>
<td>For T &gt;34 degrees C, turn cooling blankets on and place ice packs</td>
</tr>
<tr>
<td>b.</td>
<td>For T &lt;34 degrees C, turn cooling blankets off and remove all ice packs.</td>
</tr>
<tr>
<td>4.</td>
<td>Monitor vital signs and I &amp; O as per ICU protocol.</td>
</tr>
<tr>
<td>5.</td>
<td>Monitor blood glucose closely and give IV insulin as per Insulin drip protocol.</td>
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<tr>
<td>6.</td>
<td>Maintain blood pressure on vasopressors or others as ordered.</td>
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<tr>
<td>7.</td>
<td>Maintain PCO2 at 35-45.</td>
</tr>
<tr>
<td>8.</td>
<td>Monitor for presence of cardiac arrhythmias.</td>
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<tr>
<td>9.</td>
<td>Continue hypothermia in conjunction with other orders.</td>
</tr>
<tr>
<td>10.</td>
<td>Provide medication as needed for shivering, sedation and paralysis.</td>
</tr>
<tr>
<td>11.</td>
<td>Monitor baseline and every one hour using Pain scale, Modified Ramsey Scale for Sedation- (RASS), Bedside Shivering Assessment Scale- (BSAS), for shivering, and Train of 4 for paralysis, as appropriate.</td>
</tr>
<tr>
<td>12.</td>
<td>Administer Aspirin 325 mg. suppository to all patients.</td>
</tr>
<tr>
<td>13.</td>
<td>Apply Lacrilube ointment every 8 hours to protect cornea.</td>
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<tr>
<td>14.</td>
<td>Screen for Deep Vein Thrombosus (DVT), Peptic Ulcer Disease (PUD) and Stress Ulcer Disease (SUD) for prophylaxis.</td>
</tr>
<tr>
<td>15.</td>
<td>Maintain blood pressure on vasopressors or others as ordered.</td>
</tr>
</tbody>
</table>

### Re-Warming of Therapy: Start after 24 hours from the beginning of initiation of cooling measures. Goal is for normothermia to be restored within 6 hours. (PASSIVE RE-WARMING TAKES APPROXIMATELY 8-12 HOURS-GOAL RATE IS 0.5 - 1C PER HOUR)

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Turn on ventilator heated humidifier.</td>
</tr>
<tr>
<td>2.</td>
<td>Turn “OFF” and remove cooling blankets, or re-warm with “warming unit”.</td>
</tr>
<tr>
<td>3.</td>
<td>Continue to monitor/record core temperature every hour.</td>
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<tr>
<td>4.</td>
<td>Place flannel blanket on patient.</td>
</tr>
<tr>
<td>5.</td>
<td>Do not use air blankets such as Bear Hugger unless temperature does not reach 36C [96.8F] after 12 hours of passive re-warming and remove when temperature reaches 36.5 C.</td>
</tr>
<tr>
<td>6.</td>
<td>Continue with paralysis, sedation and analgesia until normothermia is achieved.</td>
</tr>
<tr>
<td>7.</td>
<td>Once normothermia is achieved, discontinue paralysis, (unless indicated), but continue sedation and analgesia.</td>
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</table>

### External Cooling with Hypothermia Devices: Following manufacturer’
**THERAPEUTIC HYPOTHERMIA AFTER CARDIAC ARREST PROTOCOL**

recommended protocol for cooling and re-warming.

**Internal Cooling with Hypothermia Devices:** Following manufacturer’s recommended protocol for cooling and re-warming.

**Utilization of a Foley Catheter with a temperature probe if available, otherwise a rectal temperature probe.**

<table>
<thead>
<tr>
<th>CAUTIONS</th>
<th>✶Re-warming too rapidly can cause vasodilation, hypotension, and rapid electrolyte shifts✶</th>
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</thead>
</table>

**POTENTIAL LABORATORY ABNORMALITIES ASSOCIATED WITH HYPOTHERMIA:**

<table>
<thead>
<tr>
<th>Potential Lab Abnormality</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased amylase</td>
<td>No intervention unless persistent after rewarming</td>
</tr>
<tr>
<td>Increased LFTs</td>
<td>No intervention unless persistent after rewarming</td>
</tr>
<tr>
<td>Increased serum glucose</td>
<td>Follow Insulin protocol</td>
</tr>
<tr>
<td>Decreased K+, Mg, Phos, Ca</td>
<td>Correct as needed</td>
</tr>
<tr>
<td>Increased lactate</td>
<td>Optimize oxygen delivery</td>
</tr>
<tr>
<td>Metabolic acidosis</td>
<td>Optimize oxygen delivery</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td>Correct if active bleeding</td>
</tr>
<tr>
<td>Leukopenia</td>
<td>No intervention unless persistent after rewarming</td>
</tr>
<tr>
<td>Increased PT/PTT</td>
<td>Correct if active bleeding</td>
</tr>
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</table>

The following must be reported to the physician caring for the patient:

- Abnormal lab values
- MAP < 60 mmHg
- Loss of O2 saturation signal
- Inability to reach or maintain target temperature
- Signs of shivering
- Inadequate glucose control; Blood Glucose >180 for three values
- Deterioration in coma level
- Loss of bowel sounds
- Change in cardiac rhythm, or new EKG changes
- Urine output <30 cc/hr

**DOCUMENTATION**

**Bedside Shivering Assessment Scales (BSAS)**

Bedside Shivering Assessment Scales (BSAS)
(Adapted from scale used at Columbia University)

| 0= No shivering | neither visually nor with palpation of thorax |
| 1= MILD | localized to the neck and/or thorax only, may be manifest on ECG rhythm |
| 2= MODERATE | intermittent involvement of the upper extremities+/neck/thorax |
## THERAPEUTIC HYPOTHERMIA AFTER CARDIAC ARREST PROTOCOL

<table>
<thead>
<tr>
<th>TEMPERATURE CONVERSION TABLE</th>
<th>Celsius</th>
<th>Fahrenheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.0</td>
<td>100.4</td>
<td></td>
</tr>
<tr>
<td>37.0</td>
<td>98.6</td>
<td></td>
</tr>
<tr>
<td>36.0</td>
<td>96.8</td>
<td></td>
</tr>
<tr>
<td>35.0</td>
<td>95.0</td>
<td></td>
</tr>
<tr>
<td>34.0</td>
<td>93.2</td>
<td></td>
</tr>
<tr>
<td>33.0</td>
<td>91.4</td>
<td></td>
</tr>
<tr>
<td>32.0</td>
<td>89.6</td>
<td></td>
</tr>
<tr>
<td>31.0</td>
<td>87.8</td>
<td></td>
</tr>
<tr>
<td>30.0</td>
<td>86.0</td>
<td></td>
</tr>
</tbody>
</table>

### REFERENCES


### SUBMITTED BY
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### REVIEW
09/2013

### DISTRIBUTION
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