Hypothermia after Cardiac Arrest
Guideline of Care
(Revised 6/10/2005)

Increased brain temperature contributes to ischemic brain damage in patients post cardiac arrest. Studies have shown that lowering brain temperature, even by a few degrees decreases, ischemic damage. In studies of out of hospital cardiac arrest, induced hypothermia protocols have contributed to improved neurological outcomes.

Patient Selection:

Patients who have been shown to benefit from induced hypothermia include:

1. Those comatose within a six-hour post cardiac arrest (non-perfusing VT or VF) time window.
2. Those able to maintain a blood pressure, with or without pressors, after CPR.
3. Those in coma at the time of cooling. (Coma is defined as: not following commands, no speech, no eye opening, no purposeful movements to noxious stimuli. Brainstem reflexes and pathological/posturing movements are permissible.)
4. The Stroke Service should be consulted to assess and document the comatose state prior to the initiation of hypothermia. **Page 3-4 CVA (beeper 34282) for Stroke Service consult.**

Relative Exclusion Criteria:

Patients in whom hypothermia may come with increased risk include those with:

1. Major head trauma – if clinical suspicion for possible head injury with arrest, a non-contrast head CT must be performed to rule out intracerebral hemorrhage prior to cooling.
2. Recent major surgery within 14 days - hypothermia may increase the risk of infection and bleeding.
3. Systemic infection/sepsis- hypothermia inhibits immune function and is associated with an increased risk of infection.
4. Patients in coma from other causes (drug intoxication, pre-existing coma prior to arrest).
5. Patients with a known bleeding diathesis, or with active ongoing bleeding - hypothemia may impair the clotting system. Check PT/PTT, fibrinogen, D-dimer at admission.
   (**Note – patients may receive chemical thrombolysis, antiplatelet agents, or anticoagulants if deemed necessary in the treatment of the primary cardiac condition.)**

Induced hypothermia after PEA, asystolic, or in-hospital arrest has not been studied, but may be applied at the discretion of the treating physicians. Induced hypothermia is not recommended for patients with an isolated respiratory arrest.

Goal: If criteria are met, the patient is cooled using the induced hypothermia protocol for 24 hours to a goal temperature of 32-34º Celsius (89-93º F). The target time to reach the temperature goal is 6-8 hours. The 24-hour time period is from the time of initiation of cooling (i.e. NOT the time the target temperature is reached.

Preparation:

Shivering, our body's attempt at maintaining homeostasis, is a concern when trying to achieve a hypothermic state. Shivering is considered very uncomfortable, and it generates heat, thereby impairing the ability to achieve the target temperature. Additionally, the resultant energy expenditure is likely detrimental to the metabolic status of the acutely injured brain.

- When using conventional surface cooling, it will be necessary to sedate and paralyze the patient once the procedure has begun.
- However, the Arctic Sun device can efficiently control shivering with the use of specific anti-shivering sedatives.

Cooling must be done rapidly (6-8 hours) to achieve maximum effectiveness, and should be instituted as early as possible. Most studies have found it necessary to use both cooling blankets and ice packs to achieve the temperature goal. Other methods such as ice lavage, cold saline infusion, etc. may be used to help achieve target temperature.

1. Place arterial line for blood pressure monitoring.
2. A continuous temperature monitor will aid in the cooling process and prevents "overcooling."
   a) A bladder temperature probe is used to monitor the temperature.
   b) Pulmonary artery temperature probe may be used, if available.
3. It is recommended that a secondary temperature device (Exergen) be used monitor to monitor temperature as well. A bladder probe is only accurate when there is adequate urine output; therefore, an alternative to the bladder temperature probe is required in the setting of oliguria. This alternative temperature probe can be any core temperature monitor that is compatible with the Arctic Sun consol.

Methods

A. External cooling with cooling blankets and ice:

1. Eligibility confirmed and materials gathered.
2. Obtain two cooling blankets and cables (one machine) to "sandwich" the patient. The bottom blanket should have a sheet covering it to protect patient's skin. Place the top blanket over a sheet.
3. Cisatracurium (Nimbex) for microinfusion for paralysis – 0.15 mg/kg bolus, maintenance dose .03mg/kg/hr. Neither the BIS or the train of four have evidence for their use in cooling and are not recommended.
4. Midazolam (Versed) for sedation at a rate of 0.125 mg/kg/hr or Propofol (Diprivan)1mg/kg/hr while patient is paralyzed.
5. Pack patient in ice (groin, chest, axilla, side of neck); use additional measures as needed (see below) to bring patient to goal temperature. Avoid packing ice on top of chest; that may impair chest wall motion.
6. Cold saline infusion can be performed via a peripheral line or femoral venous catheter to assist in achieving goal temperature. The infusion is 30 cc/kg of 4° C normal saline over 30 minutes. This is **NOT** to be used via a jugular or subclavian line, as the safety via this method is not yet known.
7. Monitor vitals, with particular attention to arrhythmia detection.
8. Once goal temperature is reached, ice bags may be removed and the cooling blankets used to maintain temperature.

B. External cooling with Arctic Sun Vest Device:

1. Eligibility confirmed and materials gathered.
2. Take patient's temperature and place cooling pad on patient (per manufacturer's suggestion). Connect the handheld device to the machine, and turn on the "Medivance Logger" program. Make sure the program is actively downloading data prior to initiating cooling.

Given the short battery life, the handheld needs to be continuously plugged into an electrical outlet.

3. A Body Surface Area (BSA) should be recorded in the flow sheet at the time of initiating cooling. The Arctic Sun device is only effective in achieving temperature control in patients with a BSA < 2.4 M^2; therefore, individuals with a BSA > 2.4 M_2 may not be effectively cooled with this device, and alternative methods for cooling should be considered. To calculate the BSA, please refer to the clinical calculators web page found on the partners handbook website.
4. After applying pads, set target goal.
5. Medicate patient for shivering with sedation and paralyzing agents as above.
6. These pads may be used with external pacing pads. Place the external pacing pads on the chest and cover with Arctic sun pads.
7. Refer to rewarming for strategies to rewarm.

Supportive Therapy

1. A MAP goal of > 90mmhg is *preferred* from a cerebral perfusion standpoint. Hypertension is potentially additive to the neuroprotection of hypothermia. The treating team should determine the MAP goal, balancing the cardiac safety with the theoretical advantage of higher cerebral perfusion pressures. Often BP remains elevated during hypothermia as a result of peripheral vasoconstriction. *Hypo*tension is a concern during the warming phase.
2. Monitor patient for arrhythmia (most commonly bradycardia) associated with hypothermia. **If significant dysrhythmias, hemodynamic instability or bleeding develop, then active cooling should be discontinued, and the patient actively re-warmed.** An Osbourne or camel wave may be present when cooling.
3. Blood work requirements include electrolyte panel, glucose and CBC at 12 hours and again at 24 hours. Hypothermia commonly causes hy*po*kalemia, which may be exacerbated by insulin administration. Conversely, when patients are re-warmed, potassium exits cells, and hy*per*kalemia may occur. Unexplained increases in serum amylase & lipase have been observed during hypothermic therapy.
4. **All ABG measurements must be analyzed at the patient's actual body temperature**. CO_2 should be maintained in the normal range (35-45).
5. Blood cultures are drawn at 12 hours after the initiation of cooling. Infection will be masked during the cooling phase.
6. Skin care should be checked every two hours for burns caused by cold blankets. If the Arctic Sun device is utilized, check skin every 6 hours.
7. Always use a secondary temperature monitoring device when using the Arctic Sun. Record the patient temp on the Arctic Sun, the secondary temp source and the water temperature of the Arctic Sun. The water temp will help to determine the work of the machine in trying to keep the patient at target.

Passive Re-warming:

The re-warming phase may be the most critical, as peripheral beds, which were once constricted, start to dilate. This shift sometimes causes hypotension. The literature recommends that the body be re-warmed at a temperature of 0.5 - 1º C (1-2º F) every hour. It will take the patient about eight hours to passively re-warm.

At 24 hours (after the initiation of cooling):

1. Remove cooling blankets (and ice if still in use).
2. **Maintain paralytic and sedation until temperature of 36°C (96.8°F)** is reached: first discontinue the paralysis; midazolam may be discontinued once a train of 4 is achieved.
3. Monitor patient for hypotension related to re-warming, secondary to vasodilation.
4. Monitor patient for hyperkalemia during re-warming

5. **The goal after re-warming is normothermia** (i.e. avoidance of hy*per*thermia)

Controlled Re- warming:

1. The goals for controlled re-warming are the same as above passive rewarming. (see 2-5
2. If the Arctic Sun cooling vest is being used, the machine can be programmed for controlled rewarming over 6-8 hours. Dial in the desired warming rate on the machine. **The device should be programmed to maintain a target temp of 37°C (98.6°F) for the next 48 hours (72 hours total).**

The stroke service will continue to follow throughout, and will reassess the neurological status after the discontinuation of hypothermia. **For additional questions or problems, please contact Dr. David Greer (#26052)**

References:

1. Bernard SA, Gray TW, Buist MD, Jones BM, Silvester W, Gutteridge G, Smith K. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. *N Engl J Med.* 2002; Feb 21;346(8):557-63.

2. Hypothermia after Cardiac Arrest Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. *N Engl J Med.* 2002; Feb 21;346(8):549-56.

3. J.P. Nolan, P.T. Morley, T.L. Vanden Hoek, R.W. Hickey, W.G.J. Kloeck, J. Billi, B.W. Böttiger, P.T. Morley, J.P. Nolan, K. Okada, C. Reyes, M. Shuster, P.A. Steen, M.H. Weil, V. Wenzel, R.W. Hickey, P. Carli, T.L. Vanden Hoek, and D. Atkins. Therapeutic Hypothermia After Cardiac Arrest: An Advisory Statement by the Advanced Life Support Task Force of the International Liaison Committee on Resuscitation. Circulation 2003;108:118 – 121.