San Francisco General Hospital Hypothermia after Cardiac Arrest Protocol

Inclusion Criteria:
1. Cardiac arrest with return of normal rhythm (initial rhythm VF or pulseless VT; PEA and asystole can be considered if returned to normal rhythm and other criteria met)
2. Persistent decreased mental status as evidenced by no response to verbal commands after resuscitation (no waiting period required)
3. Blood pressure can be maintained at least 90 mm Hg systolic either spontaneously or with fluid and pressors
4. Known time of cardiac arrest (may consider excluding "found down" of unknown duration)

Exclusions:
1. Another reason to be comatose (e.g. convulsive status epilepticus)
2. Age < 18 or pregnancy are relative exclusions due to lack of data
3. A known terminal illness preceding the arrest
4. Known severe pre-existing coagulopathy or active bleeding (relative exclusion, esp for patients on warfarin anticoagulation at time of cardiac arrest)
5. No limit on duration of resuscitation effort; however “down time” of less than 1 hour most desirable
6. Pre-existing DO NOT INTUBATE code status and patient not intubated as part of resuscitation efforts

Protocol (goal temperature 33° C to be achieved as soon as possible):
1. Patients should be enrolled as quickly as possible. For out-of-hospital arrests, ED attending will make decision to implement protocol. For in-hospital arrests, CCU resident in charge of completed code will make decision.
2. Page on-call Neurology Consult Resident at 443-NERV (6378) for immediate initial neurologic assessment prior to pharmacologic paralysis. Do not delay initiation of hypothermia pending this assessment.
3. Cooling methods: All patients should have surface cooling begun immediately.
   a. Initiate 1-5 liter IV bolus of chilled (4°C) NS (stocked in 5E refrigerator).
   b. Place ice packs under the armpits, next to the neck, on the torso and the limbs.
   c. Two cooling blankets should be used, one under and one over the patient. Alternatively, may use vest/thigh wrap around surface cooling device if available.
4. Endovascular cooling catheter (Innercool) may be placed at discretion of Neurocritical Care Fellow (see supplement).
5. Esophageal temperature probe should be placed. Otherwise, bladder temperatures should be used.
6. Page the ICU Resident to manage the ventilator and sedation in consultation with the Neurocritical Care fellow.
7. The heated humidifier on the ventilator should be turned-off and replaced with an HME until the goal core temperature is achieved. At that point, standard mechanical ventilation humidification practices should resume.
8. The room thermostat should be turned off.
9. Administer midazolam 2-6 mg/hour and fentanyl 25-75 mcg/hour if sedation needed. Propofol can be considered as an alternative if patient is hemodynamically stable.
10. Once sedation is started, if patient has significant shivering give vecuronium 0.1 mg/kg bolus. If shivering continues then repeat vecuronium boluses or start a drip of 1 mg/hour. Titrate the drip 0-5 mg/hr to keep 1/4 twitches. Cisatracurium may be alternative if renal failure present.
11. If seizures suspected, place patient on continuous EEG monitoring.
12. Patients should be on insulin drip if glucose > 140 mg/dl, daily aspirin, on pressors and or nitrates to maintain blood pressure, and any anti-arrythmics necessary.
13. Patients may receive other cardiac interventions including systemic thrombolysis, anticoagulation, and urgent cardiac cath interventions as needed. Hypothermia should proceed concurrent with these interventions.
14. Once the patient reaches 33° C (esophageal, or blood if using endovascular catheter), keep patient at 33° C using cooling catheter (if in place) or by manipulating ice packs and surface cooling devices if necessary.
15. Begin rewarming 24 hours after the beginning of cooling (not 24 hours after target temperature is reached). Patient should be slowly rewarmed to 37.0° C over 18-24 hours:
   i. Turn room thermostat up to normal.
   ii. Turn off cooling blanket.
   iii. May use regular blankets, but not warming blankets.
16. Paralysis, then sedation, may be discontinued during or after rewarming, based on shivering and other critical care issues.

Revised 4/11/08
Supplement to the San Francisco General Hospital Hypothermia after Cardiac Arrest Protocol

Use of Endovascular Cooling Catheter

Eligibility:
All patients meeting standard inclusion and exclusion criteria for induced hypothermia following cardiac arrest are candidates for endovascular cooling (use of the intravascular cooling catheter). Placement and management of these catheters will be done under the supervision of the Neurocritical Care Fellow and/or Attending (443-1414).

Exclusions:
Any condition that precludes placement of a large-bore catheter (as large as 14 F) into the inferior vena cava via a femoral vein. History of an IVC filter placement would be an exclusion for this reason.

Protocol for Endovascular Cooling:
1. The Neurocritical Care Fellow should be paged at 443-1414 as part of the standard protocol for considering hypothermia following cardiac arrest. The Neurocritical Care Service will evaluate the patient for endovascular cooling.
2. External cooling should be initiated immediately as per the standard protocol, pending evaluation for endovascular cooling.
3. Equipment needed for endovascular cooling:
   - **Innercool Standard Console or Innercool Accutrol Console**
     All items below are single-use and individually boxed:
     - **Console-related Equipment**
       - Heat Exchange Coil
       - Disposable Circulating Pump
       - Celsius Control Circulating Set
       (Works with either Innercool Console, comes as kit with all three things)
     - **Cooling Catheter Equipment**
       - Innercool Catheter Introducer Kit (specific to 10.7 or 14 F catheter, but works with either Standard catheter or Accutrol catheter)
       - Innercool Standard or Accutrol Catheter
       - Use size 14 F as default; may consider size 10.7 F for very small patients or those who are anticoagulated
     - **Fluid for closed catheter loop**
       - 1L or 500cc bag of Isolyte 7.4
     - **Fluid that surrounds the cooling coil when seated in the Console**
       - Galden HT-135 perfluoropolyether
       - Only needs to be ‘topped off’ if level is low.
   - **Galden HT-135** is in Central Supply.
   - The Innercool Standard Console and Innercool Accutrol Console are stored in Central Supply in the basement (in the room with the CVVH machines); console-related equipment (coil, pump, circulating set) should be stored in the same room.
   - The various catheter permutations (Standard 10.7F or 14F, Accutrol 10.7F or 14F) are in the Omnicells in 5E and 5R. Extras are in Central Supply.
   - The Galden HT-135 is in Central Supply.
4. The Neurocritical Care Fellow will place an endovascular cooling catheter (and, in the case of the Innercool Standard catheter, an esophageal temperature probe). Cooling will then be initiated using the Innercool Console (directions on console) to a target temperature of 33°C.
5. A KUB should be obtained following placement of the catheter, but initiation of endovascular cooling should not be delayed pending the result of this study.
6. Once the catheter cooling system has reached goal temperature, external cooling efforts may be discontinued.
7. Sedation, paralytics and mechanical ventilation should be employed as per the standard protocol. Either midazolam or propofol may be used as the sedative agent with fentanyl as needed for analgesia. Patients may receive other cardiac interventions, including systemic thrombolysis, anticoagulation and urgent cardiac cath interventions.
8. Hypothermia will be maintained for a total of 24 hours from onset of cooling.
9. Following the 24 hour cooling phase, rewarming will be accomplished over 18-24 hours in one of two ways, depending on the catheter used:
a) For the Celsius Control catheter and console, the Neurocritical Care Fellow and/or Attending with direct
the nursing staff to shut down the console, disconnect the console from the catheter (connecting the two
free ends of the catheter and the two free ends on the console connection set), allowing for passive
rewarming to begin as per the standard protocol. The Neurocritical Care Fellow and/or Attending will be
responsible for removing the catheter.

b) For the Accutrol catheter, the Console will be reprogrammed by the Neurocritical Care Fellow and/or
Attending or by a Neurology resident under the direction of the Neurocritical Care Fellow and/or Attending
to achieve a catheter-controlled rewarming. At the end of the rewarming phase, once goal temperature is
reached, the connection set can be disconnected from the catheter (as in 9a above), and the Neurocritical
Care Fellow and/or Attending will remove the catheter.
UCSF Neurology Residents' Tips for Hypothermia Protocol:

Initial Assessment:
1. Witnessed arrest?
2. Exact time of arrest
3. Initial rhythm
4. Duration of arrest
5. Duration of CPR required to return circulation
6. Is patient comatose (no eye opening)?

Decision to Initiate cooling:
Call the Neurocritical Fellow (443-1414 at SFGH, 443-NICU at Moffitt) to discuss cooling

Initial Exam:
Focus on brain stem reflexes (pupils, corneals, oculocephalic reflex)
Focus on best motor response (will need 24hour, 3day and 7day exams).

Initiating cooling:
1. Start surface cooling measures immediately--DO NOT DELAY cooling for the sake of head CT, cardiac cath etc. All these can be done concurrently.
2. Start early and DO NOT ALLOW REWARMING
2. Use 2 liters of cold (4º C) normal saline administered “wide open”
3. Ice bags to all areas of the body
4. Place esophageal temperature probe and follow as this represents core temp better than bladder or rectal
5. NICU fellow can place an intravenous cooling catheter
6. If intravenous cooling catheter is not going to be placed, then use surface vest/thigh pad wrap around device (Arctic Sun; Innercool CoolBlue; Gaymar Rap-R-Round) if available

**Note: Main problem is not reaching target temp of 33º C fast enough. Must go to bedside and assist with surface cooling measures. If not using endovascular cooling, then be careful to avoid overshoot (< 32º C).

Maintenance:
1. Must absolutely eliminate shivering!
   **sedation and neuromuscular blockade may be needed, warm hands and feet,
2. NPO for 48 hours
3. Insulin gtt to keep glucose <140
4. Replace K+ up to 3.4 only as rewarming causes rebound hyperkalemia
5. Maintain normal Mg++ levels
6. Warm ABG to room temperature before reading
7. Maintain CPP >60 and avoid hypotension

Rewarming:
1. Begin 24 hours after cooling started.
2. Controlled rewarming to 37ºC over 18-24 hours if cooling catheter is in place.
3. If no catheter, then PASSIVE rewarming back to 37º C over 18-24 hours.
4. Maintain goal temp of 36.5º – 37º C for the first 24hours post cooling to avoid rebound hyperthermia (may need to maintain active cooling with catheter or surface measures to achieve this).

Systemic complications:
1. Cardiac arrhythmia--particularly bradycardia. Vfib unresponsive to cardioversion if overcooled.
2. Coagulopathy--platelet dysfunction and PT/PTT increase
3. UTI/PNA from poor PMN function
4. Systemic Inflammatory Response Syndrome if rewarming is too rapid
5. Metabolic abnl= hypokalemia, hyperglycemia, pancreatitis, ileus

Revised 4/11/08