

Ochsner Medical Center Protocol for Hypothermia Induction with ThermoSuit and Management of Comatose Patients Resuscitated after Nontraumatic Cardiac Arrest

Background and Rationale

Sudden cardiac arrest accounts for over 400,000 deaths per year in the United States. Patients who undergo successful resuscitation most frequently receive supportive care only, and only 5-30% of them survive to be discharged from the hospital. These patients often sustain ischemic brain injury, leaving survivors with severe disabilities. A great deal of animal research data [1-6] and preliminary human trial results suggest that systemic hypothermia can improve neurologic outcomes in these patients [7, 8].

Cardiac arrest causes a lack of blood perfusion to the brain and other organs. If successful resuscitation occurs and normal circulation resumes, the return of flowing blood to the tissues can cause a phenomenon termed reperfusion injury. This is thought to occur due to free radical production and resultant mitochondrial injury, which leads to apoptosis or programmed cell death. There is mounting evidence that hypothermia slows the metabolic processes leading to cellular damage and limits tissue injury associated with reperfusion.

A number of mechanisms for hypothermic neuroprotection have been demonstrated in the animal research literature, and there is persuasive evidence that even small decrements in brain temperature confer dramatic protection against ischemic neuronal injury. Slight elevations of temperature during ischemic periods, on the other hand, accelerate and extend detrimental changes in the brain and facilitate early disruption of the blood-brain barrier. Hypothermia works by retarding high-energy phosphate depletion during ischemia and by promoting metabolic recovery in the post-ischemic period. It also significantly attenuates the release of glutamate into the brain's extracellular space and diminishes the release of dopamine. Additionally, the inhibition of calcium-calmodulin-dependent protein kinase II which is triggered by normothermic ischemia is prevented by hypothermia, as is the ischemia-induced translocation and inhibition of the key regulatory enzyme protein kinase C [6].

Clinical Studies

Two prospective randomized trials published in 2002 compared hypothermia with normothermia in comatose survivors of out-of-hospital cardiac arrest. The first, conducted in five European countries, showed that cooling to 32-34°C for 24 hours decreased the chance of death (OR 0.74 [0.58,0.95]) and increased the likelihood of good neurological recovery (OR 1.40 [1.08,1.81] [8]. The other, performed in Melbourne, Australia demonstrated that cooling patients to 32-34°C for 12 hours increased the chance for good neurological recovery (OR 2.65 [1.02, 6.88]) [7].

Based on the data above, the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care recommend that “unconscious adult patients with return of spontaneous circulation (ROSC) after out-of-hospital cardiac arrest should be cooled to 32°C to 34°C (89.6°F to 93.2°F) for 12 to 24 hours when the initial rhythm was ventricular fibrillation (VF) (Class IIa). Similar therapy may be beneficial for patients with non-VF arrest out of hospital or for in-hospital arrest (Class IIb)” [9].

Hypothermia in Cardiac Arrest Victims at Ochsner

This protocol is designed to facilitate proper application of therapeutic hypothermia to selected cardiac arrest victims who present to the Ochsner emergency department following successful resuscitation and return of spontaneous circulation (ROSC). Hypothermia will be applied with the Life Recovery Systems ThermoSuit® System, an FDA-cleared device, which allows rapid

cooling with an externally applied cold water bath over 20-30 minutes. Following achievement of a target temperature of 32-34°C, the patient is removed from the water bath, towel dried, and maintained in a passive state of hypothermia for approximately 24 hours, after which period the patient is gradually rewarmed to normothermia.

1. Services Involved:

- Emergency medicine attending diagnoses cardiac arrest victim with return of spontaneous circulation (ROSC) and identifies patient as meeting inclusion criteria for hypothermic therapy.
- Cardiology fellow in the emergency department initiates ThermoSuit protocol.
- Cardiology attending on admitting service is notified of the decision to proceed with cooling.
- Interventional cardiology fellow on call for cath lab is paged for emergent coronary angiography and possible intervention if indicated.
- Neurology service is consulted immediately upon decision to proceed with cooling.

2. Patient Selection – The ThermoSuit is FDA-cleared for use when hypothermia is medically indicated. See inclusion and exclusion criteria checklists below.

Inclusion Criteria

All of the following must be true of the patient in order to proceed with cooling:

following ROSC (return of spontaneous circulation) after primary cardiac arrest (e.g. ventricular tachycardia/fibrillation, asystole, or PEA) with Glasgow Coma Scale 5T or below (see attached GCS score sheet for calculation of scale)

Requires mechanical ventilation

Exclusion/Inclusion Criteria for hypothermia must be completed prior to administration of therapy (check boxes which apply):

Exclusion Criteria

STOP! Do Not Proceed with treatment orders if patient has one or more of the following exclusion criteria:

Core temperature by esophageal probe measurement of 34.5 °C or lower

Arrest associated with major blunt trauma such as a motor vehicle collision or any sort of penetrating trauma such as a gunshot or knife wound

Patient is within 72 hours of major operative procedure (surgical wounds with incisions of greater than 5 cm in length)

Active bleeding or coagulopathy (INR over 3 if on warfarin or over 1.5 if not on warfarin or APTT over 1.5 times control)

Thrombocytopenia (PLT below 50,000)

Refractory VF

Cardiogenic shock (persistent shock with systolic BP below 70 mmHg despite fluids/vasopressors)

Known or suspected sepsis

Pregnancy

Not to be initiated after 6 hours of return of spontaneous circulation (ROSC)

Not to be initiated if ROSC was greater than 60 minutes after arrest (timing of ROSC to be based on estimates of first responder to the scene and information obtained from EMS personnel)

Not a primary cardiac arrest (e.g. ventricular tachycardia/fibrillation, asystole, or PEA) based on the best available assessment by EMS responders and attending emergency medicine physician

- Body size: height under 4 feet 9 inches or over 6 feet 3 inches and width over 26 inches
- Glasgow Coma Scale over 5T as determined by the ED physician

3. Cooling for LRS ThermoSuit

(For complete operating instructions, see provided operators' manual, a copy of which is kept with each device.)

1. Pre-cooling
 - a. fellow will insert esophageal temperature probe, attach to continuous temperature monitor
 - b. Insert NG tube and connect to low intermittent suction
 - c. Insert Foley urinary catheter
 - d. Place protective dressing (op-site or similar product) to protect IV site, incisions, open wounds
 - e. Place AED pads with protective dressings
 - f. Maintain airway with endotracheal tube and ventilate with ambu bag or mechanical ventilation
 - g. Meds to be administered by cardiology fellow:
 - 1) Magnesium Sulfate 30mg/kg (2 gm for average size patient) IVP
 - 2) Sedation (if needed): Propofol or Versed
 - 3) Paralysis (if needed for shivering): Pancuronium
 - 4) Dopamine (if needed to maintain systolic BP > 90 mmHg)
2. Cooling (goal 32-34°C)
 - a. Follow step-by-step instructions for the proper placement of the patient in the ThermoSuit. A quick reference guide and complete operator's manual will accompany the ThermoSuit device at all times
 - b. Begin cooling
 - c. Remove patient from suit after purge complete, towel dry patient
3. Post Cooling (goal to maintain temp at 32-34° C for 24 hours)
 - a. Continually monitor temperature (esophageal is the preferred method; nasopharyngeal placement is acceptable if there is difficulty passing the esophageal probe)
 - b. Leave patient uncovered or lightly covered with a single sheet
 - c. If temperature becomes < 32° C, rewarm as below
 - 1) Warm blankets
 - 2) Bair Hugger – available from central supply at 2-3026
 - d. If temperature becomes > 34° , apply cooling measures
 - 1) Cool air (fan and pump-bottle water spray at bedside)
 - 2) IV fluids (iced saline)
 - 3) Gaymar blanket or Cincinnati Subzero Blanketrol device (call central supply at 2-3026 and request hypothermia machine and blanket)
 - 4) Ice bags to neck, axilla and/or groin
 - e. After desired duration of hypothermic therapy (24 hours), initiate gradual rewarming
 - 1) Rewarm at less than or equal to 0.3° C per hour by covering with blankets or, if necessary, with means listed below
 - 2) Warm blankets (ideally)
 - 3) Bair Hugger (if needed) – available from central supply at 2-3026
 - 4) Continually monitor temperature until it reaches 36.5° or 97.7° F, then discontinue rewarming methods. Do not allow patient to rewarm at a rate faster than 0.3° per hour.

This protocol is the one used most often at the Ochsner Medical Center. As written, it may or may not be therapeutic for any individual patient, and, therefore, the treating physician should use this protocol as a guideline. After complete evaluation of the patient, the physician should use his best medical judgment to determine whether changes to the protocol are necessary and appropriate.

GLASGOW COMA SCALE

Eye opening response: _____

4 Spontaneous

3 To voice

2 To pain

1 None

Best verbal response: T

5 Oriented

4 Confused

3 Inappropriate words

2 Incomprehensible sounds

1 None

Best motor response: _____

6 Obeys commands

5 Localized

4 Withdraw (pain)

3 Flexion (pain)

2 Extension (pain)

1 None

TOTAL: _____

If total score < 5T (intubated), meets neurological criteria for induced hypothermia

Bibliography:

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