

VANDERBILT INDUCED HYPOTHERMIA PROTOCOL (DRAFT)

Inclusion criteria:

- Ability to initiate protocol within **6-12 hours** of return of spontaneous circulation (ROSC) after a suspected cardiac arrest
- Age 18 years or older
- Unresponsive patient not following commands after ROSC; brainstem reflexes (cough, gag, corneal) and pathological/posturing movements are permissible
- Estimated time from arrest to ROSC less than **60 minutes**

Exclusion criteria:

- Awakes spontaneously with purposeful movement
- Known pregnancy
- Initial temperature less than 93.2°F (34°C)
- Known terminal illness
- Recent major head trauma or traumatic arrest
- Other causes of coma (drug intoxication, pre-existing coma prior to arrest)
- Patients with known bleeding diathesis or ongoing bleeding

Procedure:

A. Temperature monitoring

1. Place an esophageal temperature probe or rectal temperature probe if unable to place esophageal.
2. When a Foley catheter is inserted, use a temperature sensing catheter if available.

B. Methods of cooling*

1. **External cooling with ice packs**
 - a. Place ice packs (groin, axilla, side of neck, head) ensuring protection of skin by wrapping ice packs in towels or gown.
 - b. Assess ice pack location and skin site frequently.
2. **External Cooling with Arctic Sun pads**
 - a. Application of Arctic Sun device per protocol and training.
 - b. In general, target temperature should be 32-34 °C for 24 hours from the time of the initial cardiac arrest.

3. **Cooling with IV saline**
 - a. Infuse room temperature or chilled (4 °C) normal saline IV 30 mL/kg (maximum of 2L) over 30 minutes. Do not give normal saline infusion if starting temperature less than 35 °C. *Do not infuse chilled saline through central access.*

C. *Decision on which cooling method to use

1. Prehospital hypothermia protocols differ among EMS systems; most use ice packs and/or IV saline
 - a. On arrival, place temperature probe if needed
 - b. begin implementation of Arctic Sun (B.2) if prehospital cooling was performed
2. If no prehospital cooling, on arrival to Emergency Department, initiate cooling with ice packs (B.1) and saline (B.3) while preparing for Arctic Sun use. Place temperature probe (A).
3. For direct transfer to cath lab:
 - a. continue ice packs and saline, if initiated
 - b. place temperature probe
 - c. apply Arctic Sun device
4. For direct transfer to CVICU:
 - a. apply Arctic Sun device
 - b. place temperature probe
 - c. consider ice packs and saline if not hypothermic on arrival

D. Neuromuscular blockade

1. Vecuronium 0.1 mg/kg IV bolus.
2. Repeat vecuronium 0.1 mg/kg IV bolus in one hour (may be earlier if patient demonstrating evidence of inadequate paralytic effect).

E. Sedation

1. Place a BIS monitor if available.
2. Fentanyl 100 mcg IV x1, then infuse drip at 100 mcg/hr, titrate to BIS > 50.
3. Fentanyl 100 mcg IV q5 min PRN.
4. Midazolam 2 mg IV q5 minutes initially until unresponsive to painful stimulation and for BIS > 50.
5. Midazolam 2 mg IV bolus q5 min PRN.

F. Cardiovascular/Hemodynamic considerations

1. Sinus bradycardia is the anticipated rhythm; unnecessary to treat unless clinical sequelae are present. If treatment is necessary, consider increasing target temperature or temporary pacing.
2. ECG may show Osbourne waves and/or QT-prolongation; these do not require specific treatment.
3. Ventricular fibrillation caused by hypothermia is rare at 32-34 °C.

4. Mean arterial pressure target is 80-90 mmHg to maintain adequate cerebral perfusion pressure; recommend norepinephrine as pressor of choice for hypotension; consider adding vasopressin as needed if SVR remains < 1200.
5. For hypertension, consider nitroglycerin or nicardipine infusion.
6. Consider central access, arterial line placement, and PA catheter placement for management.
7. Avoid hypovolemia as hypothermia can induce diuresis.

G. Metabolic considerations

1. Oxygen consumption decreases by ~8% per °C fall in temperature
 - a. Renal metabolism affected most up to 32°C
2. Anticipate hypokalemia during hypothermia; not necessary to treat unless level is below 2.8 mEq/L or arrhythmias are present.
3. Hyperglycemia is common during hypothermia due to decreased insulin release; liver glycogen stores may also be reduced.
 - a. Vasoconstriction may cause finger-stick accuchecks to be inaccurate.
 - b. Recommend target glucose of 110-160 while hypothermic.
4. Target magnesium level is 2 mEq/L or greater; if level is below target, give magnesium sulfate 4 grams IV and check levels q8 hours until normothermic.
5. Hypophosphatemia due to increased renal excretion
 - a. May increase infection risk, reduce ability to wean from mechanical ventilation

H. Acid-Base Disturbances

1. Hypothermia shifts the oxyhemoglobin dissociation curve to the left, resulting in oxygen saturation at a lower oxygen partial pressure; this results in less tissue oxygen extraction
2. CO₂ production is decreased, leading to an initial respiratory alkalosis during cooling
3. This can cause cerebral vasoconstriction and decreased cerebral perfusion pressure
4. Lactic acidosis can occur during mild hypothermia, due to increased fat metabolism.
5. Knowledge about the normal partial pressures of gases at varying temperatures is limited
 - a. In hypothermia, PO₂ and PCO₂ are overestimated, pH is underestimated
 - b. To correct, subtract 5mm Hg PO₂ and 2mm Hg PCO₂ and add 0.012 pH units for each °C below 37°
 - c. General consensus is not to correct ABG for temperature (alpha stat method)
 - d. Thus, to avoid respiratory alkalosis, target PCO₂ should be 45-50 and pH 7.35

I. Neurological considerations

1. Electroencephalography (EEG) – consider use due to increased risk of seizure during hypothermia.
2. BIS and TOF monitors are recommended to improve sedation.

J. Other considerations

1. Hypothermia impairs leukocyte function, resulting in an increased risk of infection.
2. Hypothermia impairs platelet function, resulting in an increased risk of bleeding; recent surgery is a *relative* contraindication to therapeutic hypothermia.
3. Anticipate ileus during hypothermia – assess and document bowel sounds every 2-4 hours – consider nasogastric tube placement and intravenous nutrition (TPN and Lipids) as needed.
4. Avoid medications labeled “do not refrigerate” including mannitol which may precipitate if cooled

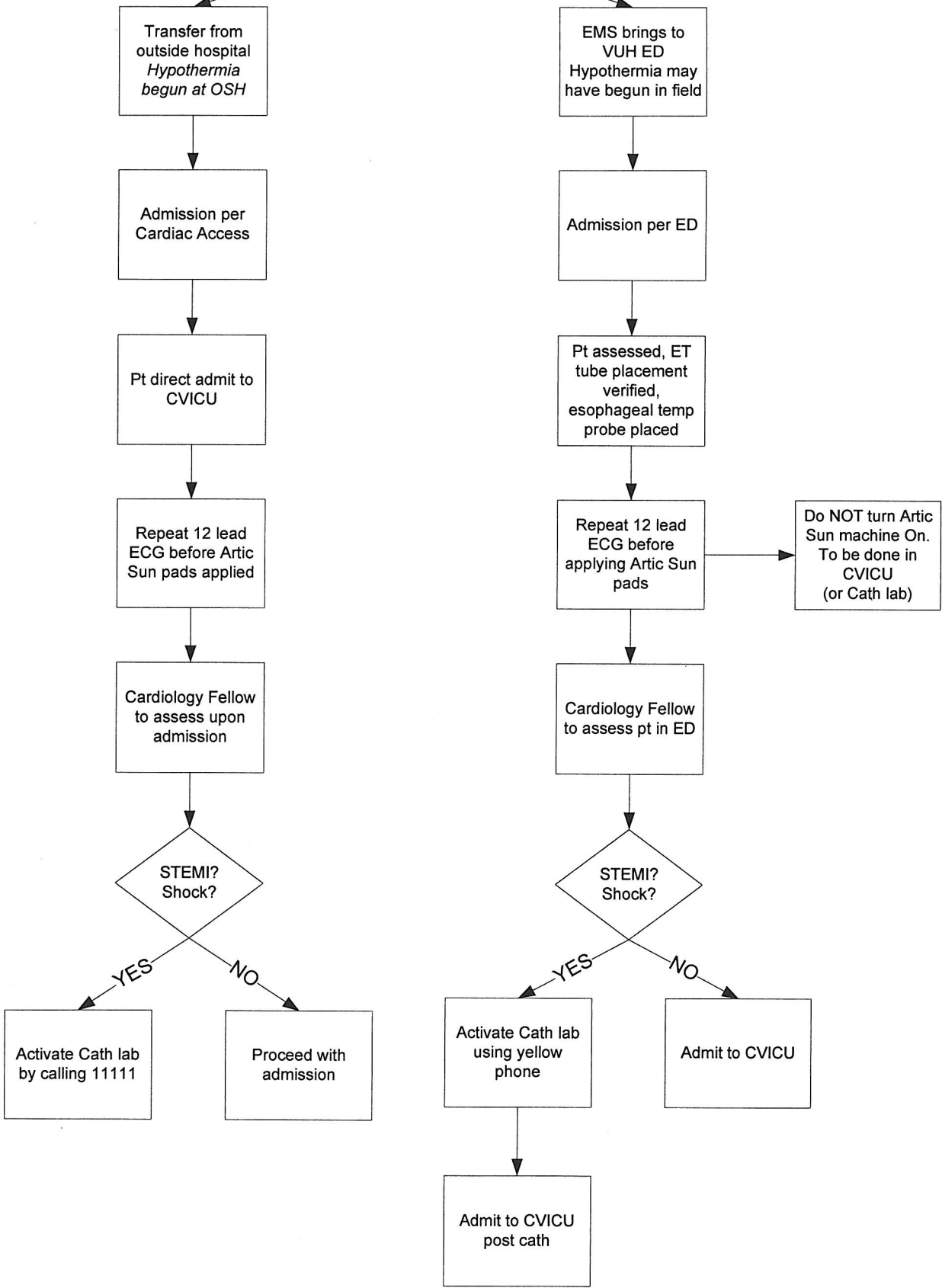
K. Rewarming Phase

1. Rewarm *slowly* at rate a temperature of 0.25°C per hour.
2. Leave Arctic Sun pads on for a minimum of 12 hours after normothermia is achieved. If temperature is labile, continue to use Arctic Sun to maintain normothermia.
3. Anticipate hypotension during rewarming phase secondary to vasodilation.
4. Anticipate a rise in potassium levels, a drop in glucose levels, and a decrease in arterial pressure during rewarming.
5. Neuromuscular blockade may be discontinued when patient temperature reaches 36 °C.

L. Patient/Family Education

1. Educate patient/family at the level of their understanding of the following:
 - a. Indications and rationale for induced hypothermia
 - b. Indications and rationale for sedation and paralytics
 - c. Effects of induced hypothermia on body systems and measures implemented to support or protect body systems
 - d. Length of time patient will be cooled
 - e. Risks associated with rewarming and steps taken to support patient during rewarming
2. Consult the Palliative Care Service, regardless of the expected outcome

CODE ICE
Post cardiac arrest



STEMI ON ICE
*Post cardiac arrest
with STEMI*

Transfer from
outside hospital
*Hypothermia
begun at OSH*

Admission per
Cardiac Access

Pt goes directly to
cath lab

Admit to CVICU
after cath

EMS brings to VUH
ED
*Hypothermia may
have begun in field
Think like Trauma*

Pt stops in ED for
quick assessment of
ETT and VS,
esophageal temp
probe placed
Pt stays ON stretcher

Quick registration by
ED
No STAT names

Pt goes to cath lab
Artic Sun pads
placed by SWAT
team and machine
turned On

Admit to CVICU
after cath