DEPARTMENT: Trauma Services	POLICY TITLE: Therapeutic Hypothermia for Refractory ICP
Page 1 of 6	POLICY DATED: New
EFFECTIVE DATE: 02/2016	REFERENCE NUMBER: 783-110

PURPOSE: Initiate hypothermia after TBI with refractory ICP when previous Tier 1 & 2 level interventions fail. Patients who have experienced traumatic brain injuries may benefit from maintaining the body temperature in a hypothermic state.

POLICY:

I. <u>Indications for Initiating the Protocol</u>:

A. Inclusion Criteria:

1. Intubated with mechanical ventilation
2. No purposeful movement to verbal commands
3. Brainstem reflexes and pathological posturing movements permitted
4. Patients with GCS $\leq$ 7
5. Females <50 must have a negative urine HCG
6. ICP $\geq$ 25 despite Tier 1 & Tier 2 interventions, or other Tier 3 interventions deemed not appropriate or previously performed

B. Absolute Exclusion Criteria:

1. Pregnancy
2. Age $\leq$18
3. DNR/DNI status
4. Active hemorrhage
5. Persistent, hemodynamically significant cardiac dysrhythmias
6. Known history of hypersensitivity to hypothermia (Raynaud's disease, sickle cell disease, etc.)
7. Major surgery in the previous 14 days (craniotomy excluded)

C. Patients with pre-existing significant neurological disability, DAI diagnoses and age >50 should strongly be considered to be excluded.

I. <u>Protocol Initiation:</u>

A. If patient meets criteria outlined in the above inclusion criteria initiate the following:

1. Initiate BSAS protocol
2. Establish core body temperature
3. Placement of central line
4. Placement of arterial line
5. Place NG/OGT
6. Discontinue sliding scale insulin and electrolyte protocol
7. If patient >34^{o}C centigrade, bolus 500ml of 4^{o} centigrade normal saline over 30 minutes (use caution if patient has CHF or if CVP >20).
8. Temperature Maintenance Guidlelines:
    i. Determine a method to initiate and sustain cooling:
        - ☐ Internal Cooling
        - ☐ External Cooling

ii. Establish access if using internal cooling method

9. **Duration of cooling is dependent on MD discretion for a max of 72 hours**

B. Treatment Phases

1. **Phase 1: Active cooling**
   - Goal: Cool patient to target temperature within 3 hours of initiation ***(clearly note time of initiation of therapy)***
   - Obtain STAT labs: ABG with ionized Ca, CBC, BMP, Magnesium, PT/INR, PTT
   - Nutrition
     i. Trophic feeds allowed for rates ≤20ml/hr
   - Glycemic Control
     i. Finger stick blood glucose every 4 hours. Initiate Tight Control IV Insulin Algorithm PPO-620 for two consecutive blood glucose greater than 200 mg per dL. Do **NOT** exceed 50 units of insulin per hour.
   - Call physician:
     i. If goal temperature not reached in 3 hours of initiation
     ii. If BSAS >1 noted
     iii. If pH <7.35 and pCO_2 >38 or <33
     iv. If hourly fluid balance negative during cooling phase
     v. If HR <35, CPP <60, ICP >20, or MAP <60
2. **Phase 2: Maintenance**
   - Goal: Maintain euvolemia and 33^{o} centigrade
   - Labs:
     i. BMP (with magnesium, phosphorus and calcium) and ABG with ionized calcium and temperature correction, every 8 hours times the duration of hypothermic maintenance
     ii. Daily CBC
   - Cultures:
     i. Daily: blood, urine and sputum cultures
   - Urinalysis Daily
   - Daily CXR
   - Replace magnesium, phosphate, calcium and potassium as needed **(**hold replacement 4hours prior to re-warming phase**)**
   - Call physician:
     i. If BSAS >1 noted
     ii. If pH <7.30 and $PaCO_2$ >40 or <35
     iii. If hourly fluid balance negative or if urine output is <0.5ml/kg/hr during maintenance phase
     iv. If HR <35, CPP <60, ICP >20, or MAP <60
     v. Bleeding complications

3. **Phase 3: Rewarming**
    - Goal: initiate **gradual controlled** re-warming not to exceed 0.25^{o} centigrade per hour until temperature 36.5^{o} centigrade achieved
    - Continue to monitor labs as previously ordered every 8 hours until 24 hours after euthermia
    - Call MD for electrolyte replacement orders
    - If paralytic infusing, discontinue once patient has reached goal temperature and re-assess for shivering.
    - Call physician:
        i. If $PaCO_2$ >37 or <33
        ii. If CPP <60, ICP >20, or MAP <60
        iii. If BSAS >1 noted
        iv. If hourly fluid balance negative or if urine output is <0.5ml/kg/hr
        v. If any electrolyte abnormality

D. For **rebound Hyperthermia** (Temperature greater than 37.5^{o} C/99.5^{o} F) **after rewarming**:
- Resume cooling at a target temperature of 36.5^{o} C (97.7^{o} F)
- Acetaminophen (Tylenol) 1 gram rectally times 1
- Ice packs to groin and axilla
- Consider initiating Normothermia protocol (PPO-583)

E. Medications
1. Sedation (must be initiated prior to initiating cooling) / Paralysis / Analgesia:
    - ☒ Propofol (Diprivan) drip initiated at 5mcg per kg per minute. Titrate up or down by 5mcg per kg per minute every 5 minutes to a BIS of 40-60 with a maximum of 100 mcg per kg per minute.
    - ☐ Fentanyl (Sublimaze) infusion - start at 25 mcg per hour. Bolus with 25 mcg and increase infusion rate by 25 mcg per hour every 15 minutes as needed to maintain sedation (Heart rate less than 100, SBP less than 140 mmHg) to a maximum of mcg per hour to achieve a RASS of 0 to -1.
    - ☐ Morphine Infusion - Start at 2 mg per hour and titrate up or down by 1 mg per hour to achieve a RASS of 0 to -1.
    - ☐ Lorazepam (Ativan) 1 - 2 mg IV every 2 hours prn sedation while intubated.
2. Paralytics
    - ☐ Vecuronium (Norcuron) 5-10 mg IV bolus every 30 minutes as needed during shivering. **Discontinue when cooling cycle discontinued.**
    - ☐ Vecuronium Norcuron) drip at 0.8 mcg per kg per minute. Titrate up or down by 0.1 mcg per minute every 15 minute to Train of Four 1 to 2 out of 4 twitches to a maximum of 1.7 mcg per kg per minute. **Discontinue Vecuronium when cooling is discontinued or when target temperature met and no signs of shivering**

- ☐ Cisatracurium (Nimbex) 0.154 mg per kg IV push followed by an infusion of 1 mcg per kg per minute up to a maximum of 10 mcg per kg per minute. **Discontinue Cisatracurium when cooling is discontinued or when target temperature met and no signs of shivering.**

3. Artificial tears every 8 hours and prn while on paralytics.
4. Vasoactive Medications
   - ☐ Nicardipine: Initiate at 5 mg. Titrate up or down by 5 mg every 15 minutes to a SBP less than 150 mmHg to a maximum of 20 mg per hour.
   - ☐ Dopamine: Initiate at 2 mcg per kg per minute. Titrate up or down by 2 mcg per kg per minute every 15 minutes to keep SBP greater than 100 mmHg to a maximum of 20 mcg per kg per minute
   - ☐ Norepinephrine (Levophed): Initiate at 2 mcg per minute. Titrate by 2 mcg per minute every 15 minutes to keep SBP greater than 100 mmHg to a maximum of 30 mcg per minute
   - ☐ Vasopressin: Initiate at 0.6 units per hour. Titrate by 0.2 units per hour every 5 minutes to a maximum of 2.4 units per hour
5. Reglan 10mg IV/NG every 6 hours
6. Pepcid 20mg IV/NG every 12 hours

F. Electrolyte Replacement (PPO-106)
   1. Only replace for potassium less than 3.5mEq per liter during hypothermia maintenance phase, then call physician for any electrolyte abnormalities during the rewarming phase.

G. Vital Signs
   1. Every 15 minutes until target temperature is met then every 30 minutes times 2 hours, then hourly if stable
   2. Record temperature from two sites, esophageal, rectal or Foley every 30 minutes until goal achieved, then record hourly
   3. Record RASS every hour
   4. Record BSAS every 30 minutes then record every hour

H. Activity
   1. Bed rest
   2. Head of the bed at 30^{o} while maintaining head at neutral alignment
   3. Log roll every 2 hours once temperature goal is met and if not contraindicated
   4. Oral care every 2 hours
   5. Heel protection

I. VAP Bundle
   1. Discontinue daily SBT while on hypothermia protocol.

I. Protocol Termination

- Protocol terminates 24hours after euthermia

Cooling Phase	
Internal Cooling-Alsius	**External Cooling-Arctic Sun**
▪ Packing in ice NOT necessary ▪ Once catheter is placed, temperature is automatically decreased per machine settings. ▪ Document temperatures every 30 minutes until temperature as desired degree, then every 1 hour during maintenance phase. ▪ Assess skin integrity beneath cooling catheter every 4 hours. ▪ Note any bleeding from catheter site.	▪ Pack patient in ice: place ice packs under the patient's axillae, next to the neck and groin. Ice packs may be removed after temperature reaches 33^{o} Centigrade (91.4^{o} Fahrenheit) ▪ Obtain wraps, cables, and Arctic Sun system to place below and on top of patient. ▪ Set machine to "MANUAL" mode and set temperature to the lowest setting. ▪ Once temperature within desired range, less than 34^{o} remove ice bags and switch mode to "AUTO". ▪ Set the target temp to 33^{o} C ▪ Document temperature every 30 minutes until desired temp reached, then every 1 hour ▪ Assess skin integrity every 2 hours for injury or blistering from ice packs or cold wraps

Maintenance Phase	
Internal Cooling-Alsius	**External Cooling-Arctic Sun**
▪ Automatic-No settings to maintain or change ▪ Document core temperature from device Q1h ▪ Assess skin integrity beneath cooling catheter Q4h ▪ Note any bleeding at catheter insertion site	▪ **Remove ice bags** to prevent excessive drop in patient's core temperature ▪ **Switch to "AUTO mode"** and set the target temp to 33^{o} Centigrade ▪ Document core temperature from device Q1h ▪ Check skin every 2 hours for injury caused by ice or cold wraps

Rewarming Phase-same for either method	
Internal Cooling-Alsius	**External Cooling-Arctic Sun**
▪ Begin rewarming **at physician ordered time** ▪ Rewarm **at the physician ordered rate** (most patients require approx. **8 hours** to rewarm unless otherwise ordered ▪ Document temperatures every 30 minutes until at goal ▪ Goal after rewarming is normothermia ▪ It is preferred to keep catheter in place for ~48 hours. Notify MD for order to remove if still in place by day 4.	▪ Begin rewarming **at physician ordered time** ▪ Rewarm **at the physician ordered rate** (most patients require approx. **8 hours** to rewarm unless otherwise ordered ▪ Document temperatures every 30 minutes until at goal ▪ Goal after rewarming is normothermia ▪ It is preferred to keep catheter in place for ~48 hours. Notify MD for order to remove if still in place by day 4.

REFERENCES:

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