Neonatal Body Cooling Protocol

Purpose: To outline the purpose and care of the infant receiving **hypothermia** as a treatment.

Supportive Data: Hypoxic-ischemic injury remains an important cause of perinatally acquired brain injury in full term infants. The best predictor of mortality and long-term outcome following perinatal injury is the presence of neonatal encephalopathy. If moderate encephalopathy is present, the risk of death is small (< 10%) and as many as 1/3 of the survivors have infanthood physical disabilities. With severe encephalopathy, mortality is higher (as much as 60%) and many, if not all survivors are handicapped. Induced hypothermia with total body cooling has been used to reduce the incidence of death and disability in full term infants having encephalopathy that follows an acute perinatal hypoxic-ischemic event.

Inclusion criteria

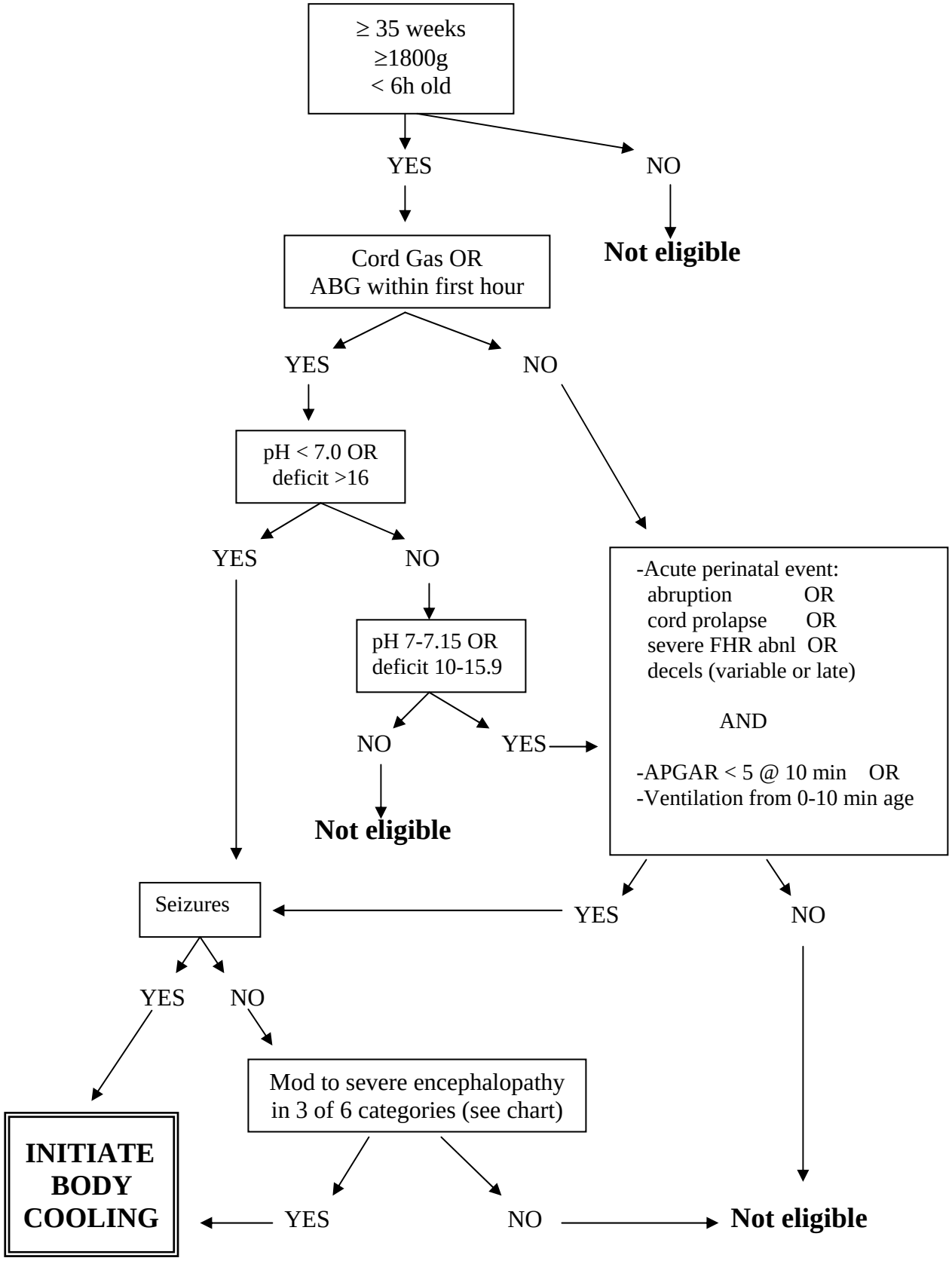
Infant must meet both physiologic and neurologic criteria. See attached Body Cooling Algorithm.

A. Physiologic criteria (Blood gas is defined as (A) a cord gas, or (B) any blood gas within the first hour of life.)
   1. Blood gas pH <7 or base deficit of > 16, then proceed to neurologic criteria.
   2. No blood gas or blood gas pH 7-7.15 or base deficit of 10-15.9 with an acute perinatal event (abruption placenta, cord prolapse, severe FHR abnormality: variable or late decels), plus either a or b, then proceed to neurologic criteria.
      a. A 10 minute apgar less than 5
      b. A continued need for ventilation initiated at birth and continued for at least 10 minutes.

B. Neurologic Criteria
   1. The presence of seizures is automatic inclusion
   2. Physical exam consistent with moderate to severe encephalopathy in 3 of the 6 categories.

	Neuro Exam	**Moderate Encephalopathy**	**Severe Encephalopathy**
1	Level of Consciousness	Lethargic	Stupor or coma
2	Spontaneous movement	Decreased activity	No activity
3	Posture	Distal flexion	Decerebrate
4	Tone	Hypotonia (focal, general)	Flaccid
5	Primitive reflexes • Suck • Moro	 Weak Incomplete	 Absent Absent
6	Autonomic system • Pupils • Heart rate • Respiration	 Constricted Bradycardia Periodic breathing	 Dilated, nonreactive Variable Apnea

Body Cooling Protocol



Exclusion criteria

1. Gestational Age < 35 weeks
2. Birth weight less than 1800 grams
3. Unable to initiate body cooling within 6 hours.

Equipment

Blanketrol Cooling Device
Cooling blankets (Maxi-therm Lite)
Esophageal temperature probe

Part C: Cooling Protocol (Order set in CPOE)

1. Prepare bed
    a. Do not turn on bed warmer.
    b. Place Maxi-therm Lite cooling blanket on bed. Place Blanketrol II or III cooling unit next to bed.
2. Place infant on blanket. There can be one chux between infant and the cooling blanket to prevent soiling.
3. Document time when cooling was initiated on Neonatal Body Cooling Worksheet. This will serve as hour 0. **Cooling will continue for 72 hours**.
4. Place skin temperature probe on the infant on the abdomen and may need to be repositioned to avoid direct contact with the bed. The SpaceLabs monitor skin probe will be used, not the radiant warmer skin probe. The radiant warmer must remain turned off during the cooling phase.
5. Place continuous esophageal temperature probe under supervision of medical providers. Nasal route is preferred. Appropriate placement is in the distal 1/3 of the esophagus. Calculation for depth of insertion: (patient length in cm divided by 5) + 4.8 cm. Round up to the nearest whole number and that is the depth when taped at the nose. Placement will be confirmed by CXR.
6. Distal end of the probe is placed into the designated outlet on the Blanketrol console.
7. Place cardio-respiratory leads on the infant.
8. Place pre and post ductal pulse oximeter probes on the infant.
9. Operate the Blanketrol cooling unit in the Automatic Control Mode. Set desired temperature to 33.5°C.
10. Adjust temperature of blanket to achieve goal esophageal temperature of 33.5°C. All management will be based on esophageal temperature. Goal temperature should be obtained as quickly and safely as feasible.
11. Respiratory Care: All inspired gases will be set at 36°C. DO NOT change this temperature in an attempt to help cool the infant.
12. Reposition the infant every 6 hours and assess skin for areas of redness/breakdown/necrosis.
13. The infant's body must remain in full contact with the Maxi-therm Lite blanket.

Monitoring Procedure

1. Temperature will be monitored using continuous esophageal and skin temperature measurements.

    All clinical decisions will be made using the esophageal temperature. Skin temperature monitoring acts as a safety measure that provides continuous back-up monitoring in case of esophageal probe malfunction. An esophageal temperature of 33.5°C should correspond to a skin temperature of 31.5-32°C.

Record measurements:

a. Q 15 minutes for hours 0-2.
b. Q 30 minutes for hours 2-4.
c. Q hour for hours 4-72.

Note: Shivering is not unusual in these infants. Medications will not be used to stop the shivering.

2. Heart rate, Blood Pressure, Respirations

a. Lower limit of HR monitor changed to 90 bpm as the HR of the infant being cooled will be in the low 100's or below 100. Heart rates in the 70's will be tolerated as long as the infant has a normal sinus rhythm, stable BP, and saturation.

b. Record measurements:

a. Q 15 minutes for hours 0-2.
b. Q 30 minutes for hours 2-4.
c. Q 1 hours for hours 4-6.
d. Q 3 hours for hours 6-72.

Laboratory Evaluation Schedule (all hours refer to hours post start of cooling protocol, not hours of life)

1. At 0 hour: CBC, Chem 10, Coags (PT, PTT, INR, Fibrinogen), LFTs (AST, ALT, total protein, albumin, total bili, direct bili, alk phosphase, GGT), and blood gas if not previously obtained.
2. At 12 hours: blood gas (either POC or lab gas with-iCa & glucose), Chem 10.
3. At 24 hours: blood gas (either POC or lab gas with-iCa & glucose), Chem 10, Coags, CBC, LFTs
4. At 36 hours: blood gas (either POC or lab gas with-iCa & glucose).
5. At 48 hours: blood gas (either POC or lab gas with-iCa & glucose), Chem 10, CBC
6. At 60 hours: blood gas (either POC or lab gas with-iCa & glucose).
7. At 72 hours: blood gas (either POC or lab gas with-iCa & glucose), Chem 10, LFTs

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Access:

The goal is to obtain central line access if at all possible: umbilical arterial and umbilical venous access is preferred. If unable to obtain umbilical access, a peripheral arterial line for continuous blood pressure monitoring/lab draws and/or a peripheral IV will be inserted.

Nutrition

Keep NPO.

Meds

Maintain adequate sedation to provide comfort.

Rewarming—After completion of 72 hours of total body cooling

1. Gradually increase the infant's core body temperature by manually increasing the Blanketrol Set Point by 0.5°C per hour. The final goal temperature is 36.5°C and should take ~ 7 hours to achieve. **DO NOT TURN ON THE INFANT WARMER UNTIL 36.5°C IS REACHED**.
2. During rewarming:
   a. Record esophageal and skin temperatures q 30 minutes until goal temperature is achieved.
   b. Record HR, RR, and BP q 2 hours until goal temperature is achieved.
   c. Once goal temperature is achieved, vital signs q 3 hours.
   d. Once goal temperature is achieved, continue esophageal temperature monitoring for another 24 hours.

3. Obtain the following labs once the goal temperature of 36.5°C is achieved:
    a. Chem 7 (including glucose)
    b. Coags (PT, PTT, INR, Fibrinogen)
    c. CBC
    d. ABG with lactate.
4. A brain MRI will be done at the discretion of the primary team.

Transport

1. During the initial call to the referral facility, inform the referring Provider:
    a. Not to use any exogenous heat sources (do not turn on the radiant warmer heat).
    b. Place a skin temperature probe and set the servo temp at 34.5°C.
    c. Obtain a blood gas and serum lactate level.
2. On transport:
    a. Monitor axillary temperatures q 15 minutes while enroute.
    b. Adjust the temperature in the transport isolette to attempt to maintain axillary body temperature of 34.5°C.
    c. Infant will not be actively cooled on transport.
    d. MCO (Medical Control Officer): Keep in mind that time to initiate proper cooling is important.
        1. Consider deferring line placement until admission to UNC, if feasible.
        2. Be mindful of ground transportation time if weather doesn't permit flying. We may have to send a closer Transport Team to expedite the transfer of the infant to our facility.

Expectations during Body Cooling

1. The infant will receive body cooling for the full 72 hours. Some infants' conditions may improve, but the studies show that the demonstrated benefits of cooling occur only with full 72 hours of cooling.
2. During cooling expect:
    a. Decreased heart rate
    b. Increased blood pressure initially due to increases in peripheral vasoconstriction.
    c. Increase in urine output initially due to shunting of blood to the internal organs, cold, and diuresis.
    d. Decrease in calcium, magnesium, phosphorus and potassium.
    e. Labile glucose due to relative insulin resistance decreased metabolic rate, and shivering.
3. During rewarming expect:
    a. Increase in heart rate
    b. Decrease in blood pressure due to decrease in peripheral vascular resistance.
    c. Decrease in urine output due to increases in third spacing and shunting of blood to the periphery.
    d. Electrolyte shifts, as renal and liver clearance rates change.

References

1. Anderson M, et al. "Passive cooling to initiate hypothermia for transported encephalopathic newborns." J of Perinatology. 2007 Sep;27(9):592-3.
2. Rutherford M, et al. "Mild Hypothermia and the distribution of cerebral lesions in neonates with hypoxic-ischemic encephalopathy." Pediatrics. Mar;28(3):171-5.
3. Shankaran S, et al. "Whole-body hypothermia for neonates with hypoxic-ischemic encephalopathy." N Engl J Med. 2005 Oct 13;353(15):1574-84.

4. Zanelli S, et al. "Implementation of a 'Hypothermia for HIE' program: 2-year experience in a single NICU." J of Perinatology. 2008 Mar;28(3):171-5.