



## NCCU CLINICAL GUIDELINES

### SECTION: 15

## NEUROLOGY

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Systemic cooling for Hypoxic Ischaemic Encephalopathy (HIE)  
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## SYSTEMIC COOLING FOR HYPOXIC ISCHAEMIC ENCEPHALOPATHY (HIE)

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**THIS GUIDELINE IS ONLY FOR NEONATES  $\geq 35$  WEEKS GESTATION AT BIRTH. HYPOTHERMIA IS NOT ADVISABLE FOR PRETERM NEONATES  $< 35$  WEEKS GESTATION.**

HIE following perinatal asphyxia contributes significantly to neonatal mortality and morbidity including long-term neurodevelopmental sequelae in up to 25%-60% of survivors. Evidence from high quality RCTs indicates that cooling of neonates with moderate to severe HIE is safe and reduces the risk of death or disability at 18 to 22 months of age. Therefore, cooling is the first intervention which has been proven in rigorously conducted scientific studies to be beneficial in term & near term neonates with HIE. Target rectal temperatures during the period of cooling:  $33.5^{\circ}\text{C}$  (acceptable range 33-34).

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## **PART 1 – GUIDELINE FOR MANAGEMENT IN NCCU**

***Essential: the following four inclusion criteria should be met to be eligible for cooling***

### **INCLUSION CRITERIA**

1.  $\geq 35$  weeks gestational age
2.  $< 6$ hrs post birth.
3. Evidence of asphyxia as defined by the presence of at least two of the following four criteria:
  - Apgar  $< 6$  at 10 min or continued need for resuscitation with positive pressure ventilation +/- chest compressions at 10mins.
  - Any acute perinatal event that may result in HIE (ie. abruption of placenta, cord prolapse, severe FHR abnormality etc).
  - Cord pH  $< 7.0$  or base deficit of 12 or more.
  - If cord pH is not available, arterial pH  $< 7.0$  or BE  $> 12$ mmol/l within 60mins of birth (if able to do gas).
4. Moderate or severe HIE based on modified Sarnat Classification (s. table below).

***If a neonate meets eligibility criteria 1, 3, and 4 but is 6-12 hours of age, delayed initiation of cooling may be considered at the discretion of the attending neonatologists.***

The presence of moderate/severe HIE according to the modified Sarnat Classification is defined as seizures **OR** presence of signs in at least three of the six categories given below:

Category	Moderate encephalopathy	Severe encephalopathy
Level of consciousness	Lethargic	Stupor/coma
Spontaneous activity	Decreased activity	No activity
Posture	Distal flexion, full extension	Decerebrate
Tone	Hypotonia	Flaccid
Primitive reflexes	Weak suck, incomplete Moro	Absent suck, absent Moro
Autonomic system:		
Pupils	Constricted	Dilated/non- reactive
Heart rate	Bradycardia	Variable heart rate
Respirations	Periodic breathing	Apnea

When screening a neonate for eligibility of cooling, please tick/fill in below list in the medical notes. Use the dedicated stamp. This documentation applies to all neonates with HIE screened for eligibility of cooling, not just the ones who actually meet inclusion criteria and/or receive cooling.

**Individual eligibility criteria checklist (please use stamp and put in medical notes):**

- GA ≥ 35weeks Yes/no
- Apgar <6 at 10 minutes Yes/no
- Need for assisted ventilation at 10 min Yes/no
- Cord pH/postnatal pH <7 Yes/no
- Cord or postnatal base deficit >12 Yes/no
- Level of consciousness Awake/ lethargy/ stupor/ coma
- Spontaneous activity Normal/ reduced/ no activity
- Posture Normal/decerebrate/decorticate
- Tone Normal/hypotonia/hypertonia
- Suck reflex Normal/ weak/ absent
- Moro's reflex Normal/ weak/ absent
- Pupils Normal/ constricted/ dilated/NR
- Heart rate Normal/bradycardia/variable
- Respirations Normal/ periodic/ apnea
- Seizures Yes/no
- Congenital anomaly Yes/no
- Chromosomal anomaly Yes/no
- Severe IUGR (BW <1800g) Yes/no
- In extremis Yes/no
- Ano-rectal anomaly Yes/no
- Suspected head trauma or ICH Yes/no

**If the infant meets eligibility criteria for cooling, please follow the guidelines below.**

## MANAGEMENT

1. The decision to cool a neonate with HIE is made by the attending neonatologist or senior registrar.
2. In order to be effective, cooling should commence as soon as possible, i.e., within 6 hrs of birth.
3. Aim is to achieve target temperature range within 1 hour.
  - **Active cooling** – for 72 hours from the initiation of cooling.
  - **Rewarming** - 12 hours of active gradual re-warming time after completion of 72 hours of cooling.

***Note: the 84 hour period of cooling and re-warming commences from the time cooling begins and not from the time of birth.***

## ACTIVE COOLING PHASE – MAINTENANCE OF TARGET RECTAL TEMPERATURE FOR 72 HOURS USING THE MEDITHERM 3 SERVO CONTROLLED COOLING AND WARMING MACHINE

- Infant Cooling and rewarming are preferably done using the Meditherm 3. Manual cooling with cool packs is to be used in the NICU only if all the Meditherm machines are in use for other babies. Cooling should never be withheld or delayed because of unavailability of the Meditherm machine.
- Place the disposable neonatal mattress, paper side up underneath the baby. A single sheet can be used over the mattress if required.
- Connect the tubes to the grey insulated hose from the machine.
- Make sure all clamps are in the open position, both on the grey hose and on the neonatal mattress. Press the on switch, located at the front lower left of the Meditherm 3 machine. Select the centre square button, THE AUTOMATIC MODE. Tab to select the speed - choose the middle speed.
- Set the target temperature of the patient with the far lower right hand side square button. To cool below 36°C, keep the button depressed to confirm and set the new patient cooling set temperature to 33.5°C.
- The Meditherm machine will now cool the infant.
- When the infant temperature is approaching the target temp the machine will slow down automatically to prevent significant undershooting and will maintain the target temperature until the rewarming phase.

## REWARMING PHASE – THIS PHASE WILL TAKE UP TO 12 HRS.

After the period of cooling, to rewarm the infant, set the target temperature to the desired temperature 37°C, continue with the MODERATE rate setting which will rewarm the patient at 0.33°C per hour, i.e. from 33.5 to 36.5°C over 12 hours. The single patient neonatal mattresses can be used for up to 12 days. Once the infant's core temperature reaches 36.5°C at 12 hours the mattress is removed and the machine is turned off and the rectal probe is removed. Monitor neurological status closely during the rewarming phase.



**ACTIVE COOLING PHASE – MAINTENANCE OF RECTAL TEMPERATURE BETWEEN 33.0 AND 34.0 FOR 72 HOURS USING COOL PACKS**

Cooling using cool packs should be done only if all the Meditherm cooling machines are already in use. Cooling should not be delayed or withheld because of unavailability of Meditherm cooling machine. Cool gel packs are also a good method of cooling babies.

- Nurse the infant on a radiant warmer with warmer off
- Do not nurse on a sheepskin
- Do not dress
- Leave nappy unfastened
- Insert rectal probe and tape the 10cm mark to the upper inner aspect of the thigh. This depth will give an accurate core temperature. The probe remains in situ for the duration of the cooling period
- Set alarm limits for rectal temp at 33.0 – 34.0°C
- Full cardiopulmonary monitoring including invasive blood pressure if possible
- Use cold packs from the fridge, never frozen
- Always put cold packs in cotton bags

Temperature algorithm	Number of cool packs to be applied	Areas to apply
>37.0	4	Head, shoulders, neck, trunk
36.1 – 37.0	3	Shoulders, neck, trunk
35.1 - 36.0	2	Shoulders, trunk
34.1 – 35.0	1	Trunk
33.0 - 34.0	0	Nil

- When rectal temp <33.0, set radiant warmer on manual and gradually adjust heater output to maintain rectal temp at 33.0 – 34.0°C. Turn off the heater once temperature reaches 33.5.
  - If infant is ventilated, leave ventilation humidity at normal temperature
  - When hypothermia has been achieved & temperature range is stable, apply Brainz Monitor
  - Cooling should not be stopped earlier than the 72hour period. If the attending neonatal consultant decides to stop cooling earlier the reason must be documented in the medical records.
  - All other documentation/care/treatment should be as per NICU routine care of infant requiring intensive care
  - Advise/reassure parents re: appearance, cool to touch
- Caution: watch temperature range more closely in infants treated with anticonvulsants or muscle relaxants as they may cool much quicker

### REWARMING PHASE – THIS PHASE WILL TAKE UP TO 12 HRS.

- Takes place after the completion of 72 hrs of cooling and **not** 72 hrs after birth
- Rewarming process should be gradual and occur over a period of 10-12 hours; rapid rewarming may be harmful.
- Apply skin temperature probe and turn radiant warmer on if switched off
- Set servo at 34.0°C
- Increase servo temp by 0.5 every 2 hours until rectal temperature is 36.5°C
- Adjust alarm limits accordingly on rectal temp range as temp increases
- Record both skin & rectal temp hourly
- When normothermia has been achieved, **pay particular attention to avoid overheating the infant above 37°C**

### INVESTIGATIONS: PLEASE ENSURE BELOW INVESTIGATIONS ARE DONE AND RECORDED IN THE MEDICAL NOTES.

Investigations	Day 1	Day 2	Day 3	Day 4
Full blood picture	Y	Y	Y	Y
U & E's, Creat, Ca	Y	Y	Y	Y
Lactate	Y	Y	Y	N
PT, PTT	Y	Y	Y	Y
Glucose	Y	Y	Y	Y
Neuro assessment/ Modified Sarnat staging*	Y	Y	Y	Y
ABG/CBG	Y	Y	Y	Y
LFT's	Y	Y	Y	N
12 ECG (only if concerns)	-	-	-	-
Brainz Monitor	Y	Y	Y	
EEG (usually at 72hr)			Y	-
MRI (before day 8, ideally on day 4)	-	-	-	Y-

**\*Modified Sarnat staging:**

1. Mild: hyperalertness, hyper-reflexia, dilated pupils, tachycardia, absence of seizures.
2. Moderate: lethargy, hyper-reflexia, miosis, bradycardia, seizures, hypotonia with weak suck & Moro.
3. Severe: stupor, flaccidity, small to midposition pupils which react poorly to light, decreased stretch reflexes, hypothermia, absent Moro.

Follow-up: Please inform the discharge coordinator to ensure appropriate follow up including developmental assessments are arranged.

**PART 2 – THE NETS TEAM GUIDELINE FOR SYSTEMIC COOLING FOR HYPOXIC ISCHAEMIC ENCEPHALOPATHY (HIE)**

Once a call has been received from the peripheral hospital, the senior registrar or consultant will discuss with the referring GP/Paediatrician regarding the eligibility and feasibility of cooling the neonate. Once a decision is made to cool the infant, the referring physician will commence cooling using appropriate equipment.

**In addition to cooling, the rest of the management is routine and in accordance with the transport protocol.**

**EQUIPMENT ESKY CONTENTS:**

- Four cold packs at fridge temp and two frozen cold packs
- Disposable rectal temperature probe (Mallinckrodt Mon-A-Therm, size 9Fr)
- Cable to connect temperature probe to Propaq monitor
- Cotton covers for cold packs (always put cold packs in cotton covers)

**MANAGEMENT**

1. In order to be effective, cooling should commence as soon as possible and definitely within 6 hrs of birth.
2. Please advise the referring physician to avoid overheating the infant and to commence cooling if they have the resources and they are able to do so.
3. If the referring team is unable to commence active cooling, discuss the importance of **passive** cooling and aim to reach the hospital as quickly as possible to commence cooling.
4. Insert rectal probe and tape the 10cm mark to the upper inner aspect of the thigh. This depth will give an accurate core temperature. The probe remains in situ for the duration of the cooling period.
5. Connect the rectal temperature probe to the monitor (remove T2). Connect to full cardiopulmonary monitoring
6. Arterial line insertion is not a prerequisite for beginning cooling during transport. Insert an arterial line if the overall clinical condition necessitates the presence of a line.

**ACTIVE COOLING PHASE: (AIM IS TO ACHIEVE TARGET TEMPERATURE RANGE WITHIN 1 HOUR).**

1. Do not dress, leave nappy unfastened
2. When rectal temp <33.0°C, set radiant warmer on manual and gradually adjust heater output to maintain rectal temp at 33.0 – 34.0°C. Turn off the heater once temperature reaches 33.5.

3. Maintain rectal temperatures between 33.0° and 34.0°C
4. If infant ventilated, leave ventilation humidity at normal temperature
5. Cooling should not be stopped earlier than the 72 hour period. If the attending neonatal consultant decides to stop cooling earlier the reason must be documented in the medical records.
6. All other documentation/care/treatment should be as per routine care of infant requiring transport. Advise/reassure parents re: appearance, cool to touch

Temperature algorithm	Number of cool packs to be applied	Areas to apply
>37.0	4	Head, shoulders, neck, trunk
36.1 – 37.0	3	Shoulders, neck, trunk
35.1 -36.0	2	Shoulders, trunk
34.1 – 35.0	1	Trunk
33.0 - 34.0	0	Nil

**Caution: watch temperature range more closely in infants treated with anticonvulsants or muscle relaxants as they may cool much quicker.**

## REFERENCES

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## **PART 3 – GUIDELINE FOR SYSTEMIC COOLING FOR HYPOXIC ISCHAEMIC ENCEPHALOPATHY (HIE) FOR REFERRING HOSPITALS**

Dear Doctor/Nurse/Midwife

This guideline is intended for cooling asphyxiated neonates,  $\geq 35$  weeks gestation at birth, with HIE who are waiting to be transported to Princess Margaret or King Edward Memorial Hospitals for ongoing management. Cooling is not advisable for preterm neonates. All neonates who need cooling should be transported to the neonatal intensive care unit. Do not attempt to manage these sick neonates at your hospital. In addition to cooling, the rest of medical management is the same as any asphyxiated neonate with HIE. Please discuss with the senior registrar or neonatal consultant at Princess Margaret Hospital for overall management of these neonates.

### **SUMMARY**

HIE following perinatal asphyxia contributes significantly to neonatal mortality and morbidity including long-term neurodevelopmental sequelae in up to 25%-60% of survivors. Evidence from high quality studies indicates that cooling of neonates with moderate to severe HIE is safe and reduces the risk of death or disability at 18 to 22 months of age.

If you think, the neonate you are caring for meets all or some of the criteria for cooling, please discuss with the neonatologist or senior registrar on call at PMH.

### **Essential: the following four inclusion criteria should be met to be eligible for cooling**

1.  $\geq 35$  weeks gestational age (Exclusion criteria  $< 35$  weeks gestation)
2.  $< 6$ hrs post birth.
3. Evidence of asphyxia as defined by the presence of at least two of the following four criteria:
  - Apgar  $< 6$  at 10 min or continued need for resuscitation with positive pressure ventilation +/- chest compressions at 10mins
  - Any acute perinatal event that may result in HIE (ie. abruption of placenta, cord prolapse, severe FHR abnormality etc)
  - Cord pH  $< 7.0$  or base deficit of 12 or more
  - If cord pH is not available, arterial pH  $< 7.0$  or BE  $> 12$ mmol/l within 60mins of birth (if able to do gas).
4. The presence of moderate/severe HIE is defined as seizures **OR** presence of signs in at least three of the six categories given below:

Category	Moderate encephalopathy	Severe encephalopathy
<b>LEVEL OF CONSCIOUSNESS</b>	<b>LETHARGIC</b>	<b>STUPOR/COMA</b>
Spontaneous activity	Decreased activity	No activity
Posture	Distal flexion, full extension	Decerebrate
Tone	Hypotonia	Flaccid
Primitive reflexes	Weak suck, incomplete Moro	Absent suck, absent Moro
Autonomic system Pupils Heart rate Respirations	Constricted Bradycardia Periodic breathing	Dilated /non - reactive Variable heart rate Apnoea



***If a neonate meets eligibility criteria 1, 3, and 4 but is 6-12 hours of age, delayed initiation of cooling may be considered at the discretion of the attending neonatologist at PM.***

## **MANAGEMENT**

1. If the decision is made to initiate cooling at your institution after consultation with the NETS Team & prior to the arrival of the NETS Team, cooling should commence as soon as possible and within 6 hrs of birth.
2. Give the information sheet to parents and discuss with them the benefits of cooling
3. Nurse the infant on a radiant warmer with warmer off, do not nurse in incubator (=PASSIVE cooling). Many asphyxiated babies have poor temperature control, and overheating the baby may worsen existing brain damage. Thus, pay particular attention to avoid body temperature > 36.5<sup>0</sup> Celsius
4. Do not nurse on a sheepskin
5. Do not dress (=PASSIVE cooling)
6. Leave nappy unfastened
7. Full cardiopulmonary monitoring
8. If staffing and resources for monitoring and management are sufficient **and** if retrieval by the NETS team will be more than 6 hours following birth, continue passive **COOLING** and initiate **ACTIVE** cooling as per **algorithm**, if the axillary temperature after 1 hr of passive cooling is still >35.0<sup>0</sup> Celsius.
9. Use cold packs from the fridge, **never** frozen
10. Always put cold packs in cotton bags or wrap in a cotton cover or Chux.

<b>Temperature algorithm</b>	<b>Number of cool packs to be applied</b>	<b>Areas to apply</b>
>37.0	4	Head, shoulders, neck, trunk
36.1 – 37.0	3	Shoulders, neck, trunk
35.1 -36.0	2	Shoulders, trunk
34.1 – 35.0	1	Trunk
33.0-34.0	0	Nil

11. Monitor axillary temperatures every 15 minutes
12. **WATCH TEMPERATURE CLOSELY.** If axillary temp drops to <33, set radiant warmer on manual and gradually adjust heater output to maintain axillary temp at 33.0 – 34.0 . Turn off the heater once temperature reaches 33.5.
13. Aim is to achieve target temperature range within 1 hour but more importantly continue to manage airway, breathing, circulation.
14. If ventilated, leave ventilation humidity at normal temperature
15. All other documentation/care/treatment should be the same as in any asphyxiated infant waiting for transport to PMH/KEMH.
16. Advise/reassure parents re: appearance, cool to touch
17. Transfer them at the earliest to PMH/KEMH.
18. The transport team will bring all the necessary equipment to continue the cooling process during transport.
19. For further information on cooling please see the entire protocol.