

## **COOLING – THERAPEUTIC HYPOTHERMIA FOR HYPOXIC-ISCHAEMIC ENCEPHALOPATHY (HIE) IN INFANTS $\geq$ 35 WEEKS GESTATION**

*This Local Operating Procedure is developed to guide safe clinical practice in Newborn Care Centre (NCC) at The Royal Hospital for Women. Individual patient circumstances may mean that practice diverges from this Local Operating Procedure.*

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### **1. AIM**

- To select appropriate infants for therapeutic hypothermia
- To guide safe, timely and appropriate therapeutic hypothermia

### **2. PATIENT**

- Newborn infants born at  $\geq$  35 weeks gestation who meet the eligibility criteria set out below

### **3. STAFF**

- Medical and nursing staff

### **4. EQUIPMENT**

- Rectal Thermistor Probe Body Temp Probe
- Arctic Sun cooling device
  - ArcticGel Pad
- OR**
- Tecotherm Neo
  - Mattress
  - Sterile water and fill-up bottle
  - Connecting hoses
- aEEG (Brainz or Nicolet) with electrodes

### **5. CLINICAL PRACTICE**

#### **Eligibility Criteria**

The following four criteria need to be met:

1. Newborn infant born  $\geq$  35 weeks gestation; Birth weight > 1800 grams
2. < 6 hours post birth
3. Perinatal depression defined by at least one of the following:
  - Apgar score  $\leq$  5 at 10 minutes
  - Continued need for resuscitation at 10 minutes of life
  - pH < 7.00 OR base excess > -12 mmol/L (on cord blood or within first hour)
  - Lactate > 8 mmol/

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4. **AND** evidence of moderate-severe encephalopathy at any time from 1-6 hours of age (as per the modified Sarnat criteria in the table below)<sup>1</sup>

<b>Simplified Sarnat criteria<sup>1</sup> (assess as many signs as possible)</b>			
Severity	Mild encephalopathy	Moderate encephalopathy	Severe encephalopathy
Level of consciousness	Hyperalert	Decreased – reduced response to non-painful stimulation (“lethargic”)	Absent – only responds to painful stimuli (“stupor”); or No or minimal response to pain (“coma”)
Spontaneous Activity	Normal or Increased	Decreased	None
Tone*	Normal or increased in trunk AND extremities	Hypotonia – reduced Trunk OR extremity Tone OR both	Flaccid No tone
Suck reflex	Normal or incomplete	Incomplete	Absent
Moro reflex	Strong, low threshold	Incomplete	Absent
Respiratory abnormality		Periodic breathing	Apnoea

\*Assess tone in both limbs and trunk/neck. Presence of hypotonia in either meets the criterion.

Definitions (at any time point in first 6 hours)

Moderate-severe encephalopathy:

- 3 criteria in moderate or severe category or both OR
- 2 criteria plus clinical or EEG seizures

Delineation between moderate and severe:

- Classification is based on the most criteria fulfilled in each category
- If equal numbers of moderate and severe criteria, the level of consciousness determines the severity

**Exclusion Criteria**

1. Oxygen requirement > 80% and not responding to treatment
2. Major congenital abnormalities (eg. Trisomy 13 or 18; severe inoperable congenital heart disease)  
NB. Infants with conditions that are not life-threatening (eg. Trisomy 21; tracheo-oesophageal fistula) can be considered for cooling after discussion with parents
3. Uncontrolled severe clinical coagulopathy (low platelet count or clinical evidence of abnormal clotting and/or clotting studies, which has not responded to appropriate therapy)
4. Infant not expected to survive

**Amplitude-Integrated Electroencephalogram (aEEG)**

- Application of aEEG immediately after arrival for at least 20 minutes may assist in identifying infants with encephalopathy who qualify for cooling as well as early identification of seizures.<sup>2</sup>
- Moderate to severely abnormal background activity on aEEG is defined as any of:
  - Discontinuous normal voltage (DNV)
  - Burst suppression pattern
  - Moderate or severely depressed voltage +/- seizure activity

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- Infants who have a normal aEEG throughout the first six hours and are showing no ongoing signs of encephalopathy can be actively re-warmed at the discretion of the consultant. This re-warming should occur over 12 hours and be closely monitored with on-going rectal temperature measurement.<sup>3</sup>

### **Differential Diagnosis of HIE**

- Metabolic abnormalities; congenital abnormalities; meningitis; hypoglycaemia; hyperbilirubinaemia.
- Other causes of seizures/encephalopathy including intracranial haemorrhage, perinatal stroke, and drug withdrawal.

### **When to Start Cooling**

- Cooling should be started as soon as possible after resuscitation is completed and before 6 hours of age.
- The initiation of cooling will often take the form of switching off external heat sources as a first step pending evaluation. The earlier passive cooling is initiated, the earlier the target temperature will be reached.<sup>3</sup>
- Initiation of cooling should not be delayed awaiting aEEG data and indeed could be initiated in infants showing poor response to resuscitation at an early stage while they are being evaluated further.<sup>3</sup>

### **Before Cooling**

- Ensure adequate resuscitation and support for the infant including airway, breathing, circulation and dextrose.
- Inform parents and provide them with the parent information sheet (Appendix 1).
- Avoid Hyperthermia (temp > 37 °C - this can increase the risk of adverse outcome).<sup>4</sup>
- Do not actively re-warm ventilated near-term infants with moderate/severe HIE when admitted to NICU.
- The ability to commence cooling of infants should NOT influence decisions to cease resuscitation attempts at birth or to consider for withdrawal of intensive care at a later point.

### **Cooling Procedure**

#### Aims

- To achieve target temperature range within 30 minutes (rectal temp 33.0 °C – 34.0 °C).
- Continue to manage Airway, Breathing, and Circulation.

#### Active Cooling

- Time period is 72 hours from the initiation of cooling.
- Set infant up on ArcticGel pad OR Tecotherm Neo mattress (see Royal Hospital for Women NCC Nursing LOP – Cooling Therapy - Tecotherm Neo Set up and Cooling Therapy – Arctic Sun).  
It takes 25-35 minutes to reach the set rectal temperature of 33.5 °C.
- Insert the rectal probe 5 cm into the anus and secure to the inside of infant's thigh and attach to the device in use.
- Select *HYPOTHERMIA* from the main screen of Arctic Sun OR *SERVO-CONTROLLED TREATMENT* from Tecotherm.

#### Active Rewarming

- 12 hours of gradual rewarming using Arctic Sun OR Tecotherm Neo after completion of 72 hours of cooling.

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### Ongoing Monitoring and Management

- Continuous rectal temperature.
- Continuous arterial blood pressure wherever possible or at least 4 hourly non-invasive blood pressure monitoring.  
Hypotension: Treatment with volume replacement and/or inotropes should be considered if the mean arterial blood pressure is less than 40 mmHg. A bolus of 10-20 ml/kg of normal saline may be given initially and if the blood pressure remains low, consider using inotropes (either dopamine or dobutamine).
- Continuous aEEG monitoring for duration of cooling. Monitor for seizures and background.
- Blood Gas (arterial access is usually obtained) – 4 hourly at least initially then as required by clinical state (includes glucose and lactate and ionised calcium).
- Electrolytes – 8-12 hourly initially then as required at least daily until day 3-5.
- Full Blood count – 12 hourly initially then as required by clinical state but at least daily until day 3-5.
- INR and APTT clotting studies – on day 1 and at least daily until normal.
- LFTs and troponin – on day 1, day 2 and day 5.
- Renal Impairment: As a guide, infants with history of perinatal hypoxia will require around 40-60 ml/kg/day. Infants in renal failure should receive a total of 30 ml/kg/day plus any measured losses. Boluses of 0.9% saline may be required to avoid hypovolaemia if diuresis occurs or if vasodilatation occurs during rewarming.
- Enteral Feeding: Minimal enteral feeding (10 mL/kg/day to 20 mL/kg/day) during hypothermia is thought to be safe and feasible for newborns with HIE. Giving more than minimal feeds is not advised because gut perfusion may be reduced during cooling.<sup>5</sup>
- Sedative Therapy: Signs of distress include tachycardia, facial grimacing and irritability. A heart rate consistently above 110 bpm in cooled infants suggests the infant may be distressed. Ventilated infants may be sedated with intravenous morphine infusion 10 microg/kg/hr. Infusions of morphine at rates higher than 10 microg/kg/hour should be used with caution.<sup>6</sup>
- Skin monitoring to minimise the risk of subcutaneous fat necrosis. This is rare and is characterised by indurated erythematous nodules and plaques over the back, arms, buttocks, thighs and chest.

### Communication to parents

- Advise/reassure parents re: infant's skin appearance.
- Infants will be cool to touch and may shiver.

### Stopping Cooling Early

- Consider stopping cooling early if there is:
  - Persistent hypoxaemia in 100% oxygen
  - Life-threatening coagulopathy despite treatment
  - Arrhythmia requiring medical treatment (not sinus bradycardia)
  - After mutual discussion between parents and senior clinicians

### Electroencephalogram (EEG) and Magnetic Resonance Imaging (MRI)

- All cooled infants should have a formal EEG after birth.
- All infants with moderate-severe HIE who are cooled and have an initial abnormal neurologic examination should have an MRI with DWI and MRS at 3 to 7 days of life (days 4–5 following rewarming is preferred).<sup>7,8</sup>
- Early MRI may help with decision making in regards to palliation.

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### **Side Effects / Complications / Precautions** (see also “Stopping Cooling Early” above)

- The following are all associated with therapeutic hypothermia:
  - Sinus bradycardia is common (HR 80-100/min)
  - Mild thrombocytopenia (50,000- 80,000)
  - Hypotension requiring inotropic treatment
  - Prolonged QT interval
  - Increased oxygen requirements and/or PPHN
  - Low pCO<sub>2</sub> (check arterial or capillary pCO<sub>2</sub> on ventilated infants regularly and ensure the low temperature is entered when putting a gas into the blood gas machine) – an infant’s pCO<sub>2</sub> can be up to 20% lower at 33.5 °C than at 37 °C
  - Anaemia
  - Leukopenia
  - Hypoglycaemia
  - Hypokalaemia
  - Urinary retention
  - Prolonged drug half-lives – morphine and phenobarbitone
  - Increased bleeding tendency or coagulopathy
  - Hypocalcaemia

### **Follow-Up**

- All babies that are cooled are to be followed up in the growth and development clinic until at least 2 years of age.

## **6. DOCUMENTATION**

- eMR
- Daily Care Plan
- Neonatal Observation Chart
- NICUS database

## **7. EDUCATIONAL NOTES**

### **Cooling in HIE**

- Moderate to severe HIE is a significant cause of early mortality and permanent major disability in term infants. While it occurs in 1-2 per 1000 live births in resource rich countries<sup>9</sup>, the incidence is much higher in countries with limited resources where it is thought to be responsible for over 20% of neonatal mortality.<sup>10</sup>
- Severe hypoxia with impaired cerebral blood flow is thought to be the main mechanism causing brain injury after intrapartum hypoxia-ischaemia. Following resuscitation and reperfusion, there is a latent period of 1 to 6 hours where the impairment of cerebral oxidative metabolism can at least partially recover before irreversible failure of cellular and mitochondrial function occurs.<sup>10</sup>
- Cooling (Therapeutic Hypothermia) appears to have its effect by reducing this delayed secondary injury to the brain. It has been shown to be effective in both animal and human studies and is the current standard treatment for newborns 35-36 weeks gestation or greater with moderate-severe neonatal encephalopathy related to intrapartum hypoxic events.<sup>11-14</sup>

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- The most recent 2013 Cochrane Review of cooling in term and near term infants cooling demonstrated reduced mortality with better neurodevelopmental outcomes for survivors. Findings from 8 of 11 randomised controlled trials (1344 infants) demonstrated cooling decreased the combined outcome of mortality or major neurodevelopmental disability to 18 months of age (46% [312/678] vs 61% [409/666] in the controls; typical risk ratio (RR), 0.75; 95% CI, 0.68–0.83.<sup>12</sup> The number needed to treat (NNT) with cooling to benefit 1 newborn is 7 (95% CI, 5–10). Findings from 8 of the trials (917 infants) also demonstrated cooling decreases disability in the infants who survived (26% [130/495] vs 39% [166/422] in controls; typical RR, 0.77; 95% CI, 0.63–0.94; for an NNT of 8 (95% CI, 5–14).<sup>15</sup>
- It is important to state that although cooling has been effective at improving outcomes, infants with moderate to severe HIE remain at a 30-70% risk of death or disability despite being cooled.
- Recent retrospective studies suggest that infants with mild HIE may have sequelae and perhaps should be considered for therapeutic hypothermia. However, at this point, there is insufficient data to make this recommendation.

### aEEG/EEG in HIE

- Seizures occur in 45-55% of infants with HIE receiving cooling. aEEG is a simplified method for real-time continuous monitoring of brain activity that is increasingly used in the NICU. The aEEG set-ups we use are processed 4-channel EEG's that are filtered and time compressed. Current evidence demonstrates the aEEG to be useful in monitoring cerebral background activity, diagnosing and treating seizures and in assisting the prediction of neurodevelopmental outcomes for Term infants with HIE.<sup>16-21</sup>
- The aEEG is also a useful additional tool for identification of encephalopathy and seizures. Seizures may be subclinical in up to 50% of cases. Cooling does not seem to affect aEEG background activity.<sup>21</sup> See RHW aEEG (Brainz/Nicolet) Protocol Clinical Guidelines – Medical for pictures showing different aEEG patterns including seizures.
- **Classification of aEEG<sup>22</sup>** is done by looking at the background - the lower and upper margin amplitudes of the activity band

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Background Pattern	Lower Margin of aEEG trace*	Upper Margin of aEEG trace*	Comments
<b>Normal</b>			
Continuous Normal Voltage (CNV)	> 5 $\mu$ V	> 10–25 $\mu$ V	Sleep Wake Cycling (SWC) is normal (usually indicates a healthy brain)
<b>Abnormal</b>			
Low CNV	< 5 $\mu$ V	> 10 $\mu$ V	Minimum amplitude may be variable
Discontinuous Normal Voltage (DNV)	< 5 $\mu$ V	< 10 $\mu$ V	
<b>Severely Abnormal</b>			
Burst-suppression	< 5 $\mu$ V	-	Bursts with amplitude > 25 $\mu$ V activities lasting 1–10 s with suppressed activity of < 5 $\mu$ V lasting > 2 sec
Low Voltage	< 5 $\mu$ V	< 5 $\mu$ V	Some variability present
Flat	< 5 $\mu$ V	< 5 $\mu$ V	Isoelectric

\*These values refer to the cross-cerebral aEEG activity band for term neonates

- In a recent meta-analysis of 21 studies using EEGs, burst-suppression (sensitivity 0.87 [95% CI (0.78–0.92)]; specificity 0.82 [95% CI (0.72–0.88)]), low voltage (sensitivity 0.92 [95% CI (0.72–0.97)]; specificity 0.99 [95% CI (0.88–1.0)]), and flat trace (sensitivity 0.78 [95% CI (0.58–0.91)]; specificity 0.99 [95% CI (0.88–1.0)]) in the EEG of term neonates with HIE most accurately predicted long-term neuro-developmental outcome.<sup>16</sup>
- Time to recovery of the aEEG background is useful to prognosticate in HIE. Even infants with a severely abnormal background pattern (burst suppression) in the first 6 hours of life had a good likelihood of survival without significant disability if the pattern normalised within the first 24 hours of life.<sup>18</sup> Furthermore, a persistently abnormal aEEG at 48hr or more is associated with a very high risk of an adverse neurodevelopmental outcome.<sup>19-21</sup>
- While a normal aEEG at 6hrs has a good negative predictive value it does not exclude an adverse outcome. Time of onset of sleep-wake cycles (SWC) may also be predictive of later outcomes. SWC is a good sign of a healthy brain. Even in infants with absent SWC initially onset of SWC within the first 36 hours of life was associated with normal outcomes, whereas those who never had normal SWC were more likely to have significant disability at 18 to 22 months.<sup>23</sup>

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### MRI in HIE

- In a neonatal primate model of brain injury acute and profound asphyxia produces injury in the basal ganglia and thalamus whereas prolonged and partial asphyxia causes diffuse injury in the white matter (watershed area).<sup>24,25</sup> Basal ganglia/thalamic injury as a result of HIE places babies at increased risk of cerebral palsy and motor problems. In keeping with this in a follow-up study basal ganglia/thalamic (BG/T) predominant injury on MRI 56% of 173 surviving infants with HIE had spastic quadriplegia, whereas only 11% of infants with the watershed predominant pattern had severe cerebral palsy (CP).<sup>25</sup> Cognitive deficits on the other hand were more apparent at 30 months than 12 months in infants with the watershed-predominant pattern, and these cognitive deficits often occurred in the absence of motor problems.<sup>25</sup>
- Certain injury patterns can offer suggestions as to the duration of asphyxia. The most severe and prolonged insults often result in diffuse neuronal injury.<sup>25</sup> Moderate to severe prolonged insults tend to lead to cortical and deep nuclear (basal ganglia and thalamic) neuronal injury.
- Other investigators have found that abnormal signal intensity in the posterior limb of the internal capsule (PLIC) on T1/T2 imaging seems to be an accurate predictor of motor outcome after birth asphyxia. Rutherford and colleagues<sup>26</sup> studied 73 term infants with birth asphyxia and reported that all who had abnormal signal intensity in the PLIC on T1/T2-weighted images had neurodevelopmental impairment (defined as any Griffith score < 85 or any neurologic abnormality on examination) at 12 months of age. The absence of normal signal in the PLIC predicted abnormal outcomes with a sensitivity of 0.90, specificity of 1.0, PPV of 1.0, and NPV of 0.89.<sup>26</sup>
- MRI with diffusion-weighted imaging (DWI) seems to be the most sensitive imaging method to detect abnormalities associated with other causes of neonatal encephalopathy, such as cerebral dysgenesis, infections, stroke and metabolic disorders. Diffusion imaging will show an area with restricted diffusion of water as increased signal intensity.<sup>27</sup> Recent studies have shown that the reduction in diffusion due to brain injury in term newborns evolves over the initial days of life, reaching its peak by 2 to 4 days after injury.<sup>28,29</sup> By day of life 3, T1/T2 changes are more apparent and diffusion changes are even more apparent. Scans on day of life 7 continue to show more obvious T1/T2 changes, but diffusion values begin to normalize (known as pseudonormalisation). In line with this concept, diffusion images acquired before 2 to 4 days may underestimate the full extent of injury.<sup>28,29</sup>
- In a large meta-analysis of 32 studies of MRI in 860 non-cooled infants with neonatal encephalopathy late MRI (defined as MRI between day of life 8 and 30) had higher sensitivity but lower specificity to predict a poor outcome (death and/or moderate/severe disability, depending on the individual study) at 12 or more months of age when compared to early MRI (performed between day of life 1 and 7).<sup>7</sup>
- Despite these limitations, recent analyses showed that predictive values of MRI do not seem to be affected by cooling although it may alter the timing of changes seen on MRI.<sup>27</sup> Rutherford and colleagues<sup>30</sup> studied 131 infants from the TOBY cooling trial (TOtal Body hYpothemia). They found that in the infants treated with therapeutic hypothermia, less BG/T lesions and fewer abnormalities in the PLIC were identified. Infants who were cooled were more likely to have normal scans. They calculated the ability of major MRI abnormalities to predict death or major disability at 18 months in both groups. In the cooled infants, sensitivity was 0.88, specificity was 0.82, PPV was 0.76, and NPV was 0.91, whereas in the non-cooled group the sensitivity was 0.94, specificity was 0.68, PPV was 0.74, and NPV 0.92.<sup>30</sup>



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- With the variety of imaging predictors available, several investigators have attempted to increase the predictive power by combining them. In a series of 19 noncooled infants with HIE and scanned with MRI and magnetic resonance spectroscopy (MRS) between day 3 and day 7 of life, Goergen and colleagues<sup>8</sup> found that either an Lactate/NAA (N-Acetylaspartate) of 0.25 or greater or bilateral DWI signal abnormality in the PLIC (agreed on by 3 radiologists) had a sensitivity and specificity of 1.0 to predict poor outcomes (death or any Bayley score <70 at 2 years). Lactate to NAA ratios have been demonstrated to be a good predictive imaging biomarker of neurodevelopmental outcomes.<sup>8</sup>

### Cooling started after 6hrs of age / Cooling in Late Preterm Infants / Cooling in Mild HIE

- Current evidence suggests that cooling initiated later than 6 hours after birth may result in a small reduction in death or disability however there remains uncertainty as to its effectiveness.<sup>31</sup> Given the relative safety of cooling and the lack of alternatives cooling can be considered in these infants on an individual basis after discussion with the consultant.
- Cooling in late preterm infants born at 34-35 weeks gestational age appears feasible. The paucity of studies and the possible increased risks of mortality and side effects mean it is currently not recommended in this group of infants.<sup>32</sup>
- Recent retrospective studies suggest that infants with mild HIE may have sequelae and perhaps should be considered for therapeutic hypothermia. However, at this point, there are insufficient data to make this recommendation.

### Recognising Encephalopathy

- One challenge in assessing newborns with suspected intrapartum hypoxic events is that not all babies with brain injury are symptomatic after birth. Some newborns who may be depressed at birth seem to recover adequately, but then become symptomatic, manifesting seizure activity after the 6-hr window when cooling is typically offered. In these cases, the insult likely occurred in a subacute fashion, allowing the fetus to “self-resuscitate” in utero. Labour is often uncomplicated and the infant does not require serious intervention at delivery. As a result, severe acidemia is not apparent, but encephalopathy may be present.
- Recognising and treating these at-risk infants remains a challenge. Some of these infants may go unrecognized initially, then develop a syndrome of encephalopathy and seizures within 12-24 hours.<sup>33</sup> A distinctly different presentation was described in a recent study of term infants treated with hypothermia. Seven infants with subacute insults based on intrapartum characteristics presented with more severe encephalopathy at birth and were less likely to require intensive resuscitation as compared with 26 with acute insults (eg, uterine rupture).<sup>34</sup>
- Subtle clues from the maternal history may be valuable (ie, decreased fetal movement), as well as characteristic MRI findings. Injury on MRI may evolve throughout the reperfusion period and the interpretation of an MRI should take this into account.<sup>35</sup> For instance, diffusion and metabolic changes worsen until day 4 or 5 and then begin to normalise.<sup>36</sup>

## 8. RELATED POLICIES/PROCEDURES/CLINICAL PRACTICE LOP

- NicoletOne (eEEG) Brain Monitor Application (RHW NCC Medical LOP)
- Cooling Therapy - Tecotherm Neo Set up (RHW NCC Nursing LOP)
- Cooling Therapy – Arctic Sun Set up (RHW NCC Nursing LOP)

## 9. RISK RATING

- Medium

## COOLING – THERAPEUTIC HYPOTHERMIA FOR HYPOXIC-ISCHAEMIC ENCEPHALOPATHY (HIE) IN INFANTS $\geq$ 35 WEEKS GESTATION cont'd

### 10. NATIONAL STANDARD

- Standard 1 Clinical Governance
- Standard 5 Comprehensive Care
- Standard 8 Recognising and Responding to Acute Deterioration

### 11. ABBREVIATIONS AND DEFINITIONS OF TERMS

HIE	Hypoxic-Ischaemic Encephalopathy	APTT	Activated Partial Thromboplastin Time
NCC	Newborn Care Centre	LFTs	Liver Function Tests
aEEG	Amplitude-Integrated Electroencephalogram	MRI	Magnetic Resonance Imaging
NICU	Neonatal Intensive Care Unit	DWI	Diffusion Weighted Imaging
LOP	Local Operating Procedure	MRS	Magnetic Resonance Spectroscopy
INR	International Normalised Ratio	PPHN	Persistent Pulmonary Hypertension of the Newborn

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Primary	18/8/2011	J Smyth (Staff Specialist)
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**FOR REVIEW: 2022**

## Cooling Treatment to help protect Babies Brains

### Parent Information Sheet

Your baby needed a lot of help to breathe at birth. He/she appears to have suffered from the effects of a lack of oxygen and blood supply to the brain. This is called moderate to severe encephalopathy and your baby may be at high risk of permanent brain damage. You have been given this information sheet because your doctor recommends COOLING your baby to help his/her problem.

#### What does Encephalopathy mean?

Encephalopathy means “dysfunction over the whole brain.” About two in a thousand newborn babies suffer from the effects of reduced oxygen supply to their brain around the time of birth and this can result in an encephalopathy. Babies can recover from an encephalopathy but when it is severe, it can result in brain damage and a high chance of disability and death. Around 30-60% of babies who survive after having a moderate to severe encephalopathy will develop long-term disabilities like cerebral palsy and mental retardation.

Moderate encephalopathy is where the baby has reduced activity and is floppy with a weak suck and weak reflexes. Babies with an encephalopathy may also have seizures (fits). Severe encephalopathy is where the baby has very little activity and is very floppy with absent reflexes and seizures.

Based on 11 scientific trials that were reviewed, cooling is known to increase the chances of survival and to reduce the severity of possible long-term brain damage / disability by between 10-35%.<sup>1</sup>

#### What is Cooling?

Cooling means that a baby is cooled from the normal body temperature of 37 °C down to a temperature of 33-34 °C. The baby is kept cool for 3 days (72 hours). This cooling is achieved by using a cooling mattress. Cooling is started as soon as possible after birth (best if before 6 hours of birth). After the 72 hrs your baby will be gradually re-warmed over 12 hours to the normal temperature of 37 °C.

There have been no severe lasting side effects in babies who have been cooled. Side effects include cooling of the skin, a mild slowing of the heart rate, mildly reduced blood pressure, a risk of clotting problems and a slight increase in the amount of oxygen your baby requires. These have not usually required any change in the cooling treatment. The doctors and nurses looking after your baby are aware of these side effects and your baby will be monitored for any signs of these. Reversing the cooling can reverse side effects if they occur. Your baby's doctors can decide to stop the cooling early if they consider this to be best for your baby.

#### How will my baby be treated when he/she is cooled?

Your baby will receive standard intensive care during cooling. You will be able to touch your baby as you would normally if he/she was receiving intensive care.

Your baby will be followed up for neurodevelopment at 1 year and 2 years of age following discharge from hospital. If you have any further questions or require any further information regarding your baby and the cooling process please ask the medical and nursing staff caring for your baby.

**Newborn Care Centre  
Royal Hospital for Women  
Randwick, NSW Tel (02) 93826160**

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## Appendix 2. RHW Criteria for Cooling Algorithm

**Does Cooling Need to Start?**



The following four criteria **ALL** need to be met:

- 1) Newborn infant born  $\geq$  35 weeks gestation; Birth weight > 1800 grams
- 2) < 6 hours post birth
- 3) Perinatal depression defined by at least one of the following:
  - Apgar score  $\leq$  5 at 10 minutes
  - Continued need for resuscitation at 10 minutes of life
  - pH < 7.00 OR base excess > -12 mmol/L (on cord blood or within first hour)
  - Lactate > 8 mmol/L
- 4) **AND** evidence of moderate-severe encephalopathy at any time from 1-6 hours of age (as per the modified Sarnat criteria in the table below)<sup>1</sup>

<b>Simplified Sarnat criteria (assess as many signs as possible)</b>				Record actual time of exam					
Severity	Mild	Moderate	Severe	1hr	2hr	3hr	4hr	5hr	6hr
Level of consciousness	Hyperalert	Decreased – reduced	Absent						
Spontaneous activity	Normal or increased	Decreased	None						
Tone*	Normal or increased	Hypotonia – reduced	Flaccid No tone						
Suck reflex	Normal or incomplete	Incomplete	Absent						
Moro reflex	Strong, low threshold	Incomplete	Absent						
Respiratory abnormality		Periodic breathing	Apnoea						

\*Assess tone in both limbs and trunk/neck. Presence of hypotonia in either meets the criterion.

Level of Encephalopathy needs to be documented every hour for the 1<sup>st</sup> 6 hours



Cooling criteria are met if at any time point infant meets any of:

- 1) 3 criteria in moderate or severe category or both OR
  - 2) 2 criteria **plus** clinical or EEG seizures
- If equal number of moderate or severe items, level of consciousness decides severity of encephalopathy