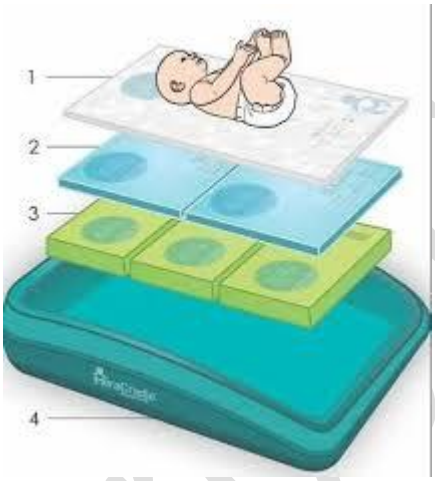
Hypoxic Ischaemic Encephalopathy (HIE)

MiraCradle®

Whole body Cooler that enables controlled cooling of newborn to support therapeutic hypothermia (TH) for birth asphyxia. The product has been developed with proprietary Phase Change Material (PCM) to maintain the temperature of the baby at 33–34°C (91.4–93.2 F) for the entire treatment duration of 72 hours. Rewarm the baby over next 12 hours (avoid warming faster than 0.5 ºC per hour).



1. **Conduction mattress (store at room temperature)**
2. **FS 21**
3. **FS 29(Store at the bottom of refrigerator)**
4. **Cradle**

- Make sure that FS29 plates are hard (Not flexible) and at temperature 23deg cel prior to use.
- Use FS21 plates if temperature fails to reach 34deg even after 30minutes of cooling therapy. Remove F21 when temperature reaches 33.6 deg. Celsius.
- If temperature falls <33.2 deg., Switch on the warmer and use manual mode at 10-20% heat output. Switch off the warmer if temperature raises >33.5deg.cel.
- During rewarming phase switch on the warmer at set the temperature 20-30% in manual mode. Maintain rewarming at 0.2-0.5deg.cel per hour.

Definition

Neonatal encephalopathy is a condition that occurs in a newborn baby born at or after 35 weeks gestation, that has features of disturbed neurological function. It is characterised by a reduced

level of consciousness or seizures, often with difficulty initiating and maintaining respiration, and with depressed tone and reflexes. While infants born at less than 35 weeks gestation can experience hypoxic ischaemic injury, their assessment and clinical management differs from that of late preterm and term infants.

Hypoxic-ischaemic encephalopathy (HIE) is a type of neonatal encephalopathy caused by systemic hypoxaemia and/or reduced cerebral blood flow resulting from an acute peripartum or intrapartum event. It is a condition which can cause significant mortality and long-term morbidity. HIE can be a clinical consequence of perinatal, birth and/or neonatal asphyxia.

Incidence

- Term intrapartum hypoxia-ischaemia is 3.7 (range 2.9–8.3) per 1000 term births
- HIE is 2.5 per 1000 live births

Risk factors

1. **Maternal:** Thyroid disease, hypertension, GDM, infection, uterine rupture, birth injury complications
2. **Foetal:** FGR, low Apgar scores
3. **Feto-placental:** Multiple pregnancy, oligohydramnios, polyhydramnios
4. **Intrapartum events:** Prolonged shoulder dystocia, abnormal foetal heart rate pattern

Eligibility criteria for therapeutic hypothermia

It is recommended that TH should be offered to neonates with HIE with gestational age > 36 weeks, <6 hrs of age of life and with admission temperature 36-37.4oC, IF they fulfil all of the following criteria:

1. PH <7 or BE >-16 on cord or arterial blood gas done within 1 h of life AND

(i) Apgar score<5 at 10 minutes or at least 10 min of positive pressure ventilation AND

(ii) history of acute perinatal event (such as but not limited to placental abruption, uterine rupture, cord prolapse)

2. Evidence of moderate or severe encephalopathy

Exclusion Criteria (Do not start or continue Therapeutic Hypothermia)

1. Major congenital abnormalities likely to render therapeutic hypothermia ineffective or unsafe (Lethal chromosomal abnormality, Complex CCHD, CNS anomaly)

2. Uncontrolled severe clinical coagulopathy not responding to appropriate therapy
3. New-born not expected to survive.

Resuscitation

Maintain Airway, Breathing and Circulation. Aim for normothermia until the baby meets the inclusion criteria for therapeutic hypothermia. Measure paired cord blood gases. **Ensure a capillary, venous or arterial blood gas is taken within the first hour following birth.**

Neurological

Perform a structured neurological examination on admission, using modified Sarnat staging system to determine eligibility for hypothermia treatment. **The presence of moderate / severe encephalopathy will meet the criteria to start whole body cooling.**

Metabolic

Obtain Blood glucose level on admission. Aim for blood glucose level (BGL) above 3.5 mmol/L(>63mg/dl). Provide 4-6mg/kg/min of glucose infusion rate and Fluid bolus may be required Correct metabolic acidosis with targeted circulatory. **Routine use of sodium bicarbonate is NOT recommended: Use at consultant discretion only**. Persistent hypoglycaemia and /or metabolic acidosis should raise suspicion for inborn errors of metabolism where consultation with a Metabolic Specialist is advised.

Renal support and fluid management

Acute kidney injury is common. Strict fluid balance and fluid restriction may be necessary. Obtain formal electrolytes and creatinine as per the guidelines. Commence dextrose infusion initially at target volumes of 25-40ml/kg/day. Insert urinary catheter for assessment of fluid balance and prevention of urinary retention.

Enteral Nutrition

Enteral nutrition to a maximum of 20 mL/kg/day of breast milk may be commenced at 24 hours of age in the stable infant undergoing therapeutic hypothermia.

Seizures

Treat all clinical seizures (and electrographic seizures). Phenobarbital is first line. If seizures are refractory to treatment, discuss further management with consultant responsible. Consider alternative anti-convulsion agents (e.g. benzodiazepine, phenytoin, levetiracetam).

Analgesia

Hypothermia appears to be uncomfortable, even painful. An infusion of morphine at 5-10microg/kg/min may be beneficial.

Haematology

Obtain full blood count and coagulation profile on admission. If evidence of coagulation abnormalities, consider FFP / cryoprecipitate / platelet transfusion. Aim for INR <1.9; aPPT 40-60 sec; PT <16s; fibrinogen ≥1.5 g/L (Note: hypothermia in itself can prolong in vitro coagulation tests).

Infection

If sepsis suspected, obtain blood culture on admission and commence antibiotics. Cerebrospinal fluid (CSF) analysis should be performed if indicated when clinically stable (usually post hypothermia treatment).

Investigations:

Blood investigations

CBC, RFT, LFT, Ionised calcium, Blood gas and Coagulation profile (including fibrinogen) and occasionally cardiac troponin and CKMB levels.

Metabolic studies

Metabolic studies are not done on a routine basis but should be considered if the cause of HIE is unclear. Urine amino and organic acids, serum ammonia levels, CSF Amino acids and neurotransmitters if the cause of HIE is unclear. Rare metabolic conditions can mimic HIE.

Imaging

Cranial ultrasound should be performed to exclude neurosurgical cause for HIE or structural brain abnormality. Cranial ultrasound lacks sensitivity in newborn babies for evaluating the nature and extent of the injury. Arrange MRI on day 4-7 of life if HIE. MRI can be done earlier if needed to rule out alternative diagnosis (e.g. ischaemic/haemorrhagic stroke, cerebral malformation), or if imaging is critical for clinical decision making (e.g. redirection of care).

Skin integrity

These babies are prone to get problems with skin integrity / fat necrosis. Change the baby position regularly as tolerated to reduce pressure**.**

REF: NNF, www.sahealth.sa.gov.au**, NICHD neonatal research NICHD neonatal research**

Guideline prepared by	**Dr. Santosh Kumar A**
Guideline approved by	**Dr. Shekar Subbaiah/ Dr. Ramapriya / Dr. Kishore Yerur**
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Guideline review date	**May 2027**

Kangaroo Care
It's all about Mother & Child

NABH PRE ACCREDITED

Certification form on the expanded modified Sarnat staging based on the NICHD neonatal research network hypothermia trials.

Name of the Candidate	Video Number reviewed:	Date

THE 6 CATEGORIES:	SIGNS OF HIE IN EACH CATEGORY				Your Determination	
	NORMAL	MILD HIE	MODERATE HIE	SEVERE HIE		
1. LEVEL OF CONSCIOUSNESS	0 = Alert and responsive	1 = hyperalert/stare/jittery	2 = Lethargic	3 = Stupor/coma	= _____	
2. SPONTANEOUS ACTIVITY	0 = changes position when awake	1 = normal or decreased	2 = Decreased activity	3 = No activity	= _____	
3. POSTURE	0 = predominantly flexed	1 = mild flexion of distal joints	2 = Distal flexion, complete extension	3 = Decerebrate	= _____	
4. TONE	0 = strong flexor tone in all extremities + strong flexor hip tone	1=normal or slightly increased flexor tone	2a = Hypotonia (focal or general) 2b = Hypertonia	3a = Flaccid 3b = Rigid	= _____ _____ *(Note a or b)*	
5. PRIMITIVE REFLEXES						*Code highest level*
Suck	0 = strong, easily elicited	1 = weak, poor	2 = Weak or has bite	3 = Absent	= _____	
Moro	0 = complete	1 = partial response, low threshold to elicit	2 = Incomplete	3 = Absent	= _____	_____
6. AUTONOMIC SYSTEM						*Code highest level*
Pupils	0 = In dark: 2.5 to 4.5 mm/In light: 1.5 to 2.5 mm	1 = Mydriasis	2 = Constricted	3 = Deviation/dilated/non-reactive to light	= _____	
Heart rate	0= 100 to 160 bpm	1 = Tachycardia (>160 bpm)	2 = Bradycardia	3 = Variable HR	= _____	
Respiration	0 = regular respirations	1 = Hyperventilation (RR>60/m)	2 = Periodic breathing	3 = Apnea or requires ventilator 3a=on vent with spont breaths 3b=on vent without spont breaths	= _____	*(if vent, code a or b)*

1. Total # Categories should be NO MORE THAN 6 Total (Count Only the Highest Level in each sign)
   #_____Normal #_____ Mild #_____ Moderate #_____ Severe

2. Are there signs of HIE in at least 2 of the 6 categories above? Y N (circle one)

   If yes, What is the Level of HIE? MILD MODERATE *or* SEVERE (circle one)

Examiner approved? Y / N	Approved by _____	Date _ _/_ _/ 20 _ _

The COMET eligibility criteria require one or more abnormal categories under mild, moderate or severe but less than two categories under moderate or severe category; Spontaneous activity and suck in moderate and mild categories are the same, and the assignment should be based on the level of consciousness if the scores are equal; Primitive reflexes and autonomic nervous system have more than one category and the allocation are based on the highest grade; All neonates who require invasive ventilation should be categorised as severe irrespective of the presence or absence of spontaneous respiration.