

Therapeutic Hypothermia for Newborn in moderate to high risk of hypoxic ischemic encephalopathy

缺氧缺血性腦病變新生兒低體溫治療處理流程

Inclusion Criteria(註 1)

1. ☐ ≥ 36 weeks gestation
2. ☐ As soon as possible
3. Evidence of perinatal acute event (at least two of the following)
 - a) ☐ Apgar <6 at 10 min
 - b) ☐ Severe acidosis, defined as pH level of ≤ 7.71 and base deficit $\geq 12-16$ mmol/L (ANY blood gas obtained within 1 h of acute event)
 - c) ☐ Continued need for resuscitation at 10 minutes after initiation of resuscitation
4. ☐ The presence of moderate/severe HIE; defined as seizures OR presence of signs in at least THREE of the SIX categories given below(註 2):

Category	<input type="checkbox"/> Moderate encephalopathy	<input type="checkbox"/> Severe encephalopathy
1. Consciousness	<input type="checkbox"/> Lethargy	<input type="checkbox"/> Stupor/coma
2. Spontaneous activity	<input type="checkbox"/> Decreased activity	<input type="checkbox"/> No activity
3. Posture	<input type="checkbox"/> arms flexed, legs extended (decorticate)	<input type="checkbox"/> arms and legs extended (decerebrate)
4. Tone	<input type="checkbox"/> Hypotonia(focal or general)	<input type="checkbox"/> Flaccid
5. Primitive reflexes	<input type="checkbox"/> Weak suck, incomplete Moro	<input type="checkbox"/> Absent suck, absent Moro
6. Autonomic system (any one of) Pupils Heart rate Respirations	<input type="checkbox"/> Constricted <input type="checkbox"/> Bradycardia <input type="checkbox"/> Periodic breathing	<input type="checkbox"/> Dilated/non - reactive <input type="checkbox"/> Variable heart rate <input type="checkbox"/> Apnea

Management

1. In order to be effective, cooling should commence as soon as possible and definitely within 6 hrs of birth. (註3)
2. Aim is to achieve target temperature range within 1 hour.
3. The total period of cooling and re-warming is for 84 hrs consisting of 2 phases:
 - (1)Active cooling : for 72 hours from the initiation of cooling.
 - (2)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

Initiation of Therapeutic Hypothermia(註1)

The eventual goal: keep a body temperature 33.5°C (range: 33°C ~ 34°C) for 72 hours

Note: skin temperature-rectal BT \approx 0.5°C , for easier access, surface temperature probe is applied here

1. Explain to families and obtain informed consent
2. On EKG and SpO₂ monitor
3. If nursed in O₂ hood, do not humidify or warm the air/O₂ gas mixture, if ventilated, use normal humidify setting
4. Check continuous body temperature (BT) to keep BT within the range between 33°C to 34°C
5. Passive Cooling: turn off heater of radiant warmer to achieve BT 33°C ~ 34 °C within 1 hour
6. If BT > 34 °C one hour after initiation of Passive Cooling, start Active Cooling as follows :

腋溫°C	冰袋數	位置
>37.5	4	大腿內外側+腋下+背部+頭頸部
36.5-37.5	3	大腿內外側+腋下+背部
35.5-36.5	2	大腿內外側+腋下
34.5-35.5	1	大腿內外側
<34.5	0	無

7. The radiant warmer heater output was manually adjusted every 15 to 30 minutes if the temperature was below 33.5°C. Adjust heater to achieve rewarming rate of 0.1~0.2°C/ hour

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

Monitor during and after therapeutic hypothermia

1. Continuous BP monitor with A-line
2. Record I/O, U/O as NICU routines
3. Check PT/PTT, lactate at start of cooling and complete of rewarming
4. Baseline brain sono, heart sono
5. Check neuro-assessment/modified Sarnat staging qd

6. Check ABG q6h to keep PaCO₂ 40~50mmHg
7. Check Na, K, Ca, Mg, sugar q6h
8. Check CBC/DC qd; keep PLT >100K
9. Check BUN/Cr GOT/GPT q3d
10. EEG on day3
11. Brain MRI before day 8

Modified Sarnat staging(註4):

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.

Rewarming Phase – take up to 12hrs

1. Takes place after the completion of 72 hrs of cooling and not 72 hrs after birth
2. Turn on radiant warmer and adjust temperature to increase not more than 0.5°C every 2 hours until rectal temperature is 36.5 degrees Celsius
3. Adjust alarm limits accordingly on rectal temp range as temp increases
4. Record both skin temperature hourly
5. When normothermia has been achieved, pay particular attention to avoid overheating the infant above 37°C
6. Keep BT monitor for another 24hrs.

Reference

- 註1: Susan E. Jacobs, et al. Whole-Body Hypothermia for Term and Near-Term Newborns With Hypoxic-Ischemic Encephalopathy. Arch Pediatr Adolesc Med. 2011;165(8):692-700.
- 註2: Seetha Shankaran, M.D., et al. Whole-Body Hypothermia for Neonates with Hypoxic – Ischemic Encephalopathy. N Engl J Med 2005;353:1574-84.
- 註3: D Azzopardi, et al. The TOBY Study. Whole body hypothermia for the treatment of perinatal asphyxial encephalopathy: A randomised controlled trial. <http://www.biomedcentral.com/1471-2431/8/17>

註4: Sarnat HB, Sarnat MS. Neonatal encephalopathy following fetal distress. A clinical and electroencephalographic study. Arch Neurol 1976; 33: 696-705.