

## Therapeutic hypothermia for hypoxic-ischaemic encephalopathy (HIE)

### Standard

All infants who require therapeutic hypothermia for hypoxic-ischaemic encephalopathy will have the procedure carried out in a safe manner, by personnel who are competent in the technique.

### Equipment

- Resuscitare and Criticool box – The Criticool box is located in the clean utility room.
- Criticool box contains: Criticool Thermawrap, 1 rectal temperature probe, 1 peripheral temperature probe, 2cm wide zinc oxide tape, Duoderm, Cavilon stick, lubricant, tape measure, NGT and drainage bag for urinary catheterisation and Appeel for the removal of tape post cooling.
- Criticool mini cooling machine

All infants will be monitored using the CFAM and a multi-parameter monitor prior to commencing cooling.

### Criticool machine

Please refer to the Criticool mini step by step guide for set up, cleaning & emptying and troubleshooting information.


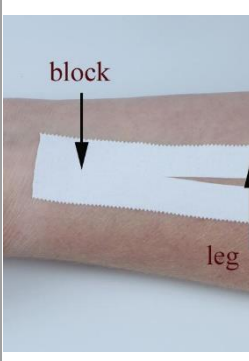



### Cooling Procedure

Rectal temperature to be maintained during active cooling at 33.5°C +/- 0.5. Cooling is maintained for 72hrs followed by at least 6 hours of re-warming. Cooling duration will be shortened if a decision is made to re-orientate care. Re-warming may last longer if seizures and hypotension occur during this stage.

### Pre-cooling sedation

#### If the infant is already intubated:

- A loading dose of morphine sulphate is administered followed by a maintenance regimen for the first 12 hours. After this time a reduced dose should be considered. Maintenance morphine should be made in 10% glucose.
- Commence cooling (see Step1).
- Neofit should be in place to secure ETT. If this requires removal for MRI, the trouser leg fixation method may be used as seen below.
- To minimize skin damage apply Cavilon to the cheeks and upper and lower lips, allow to dry for at least 1 minute before applying Duoderm patches to the cheek areas and a strip on the upper and lower lips.
- Using the trouser fixation method, secure the ETT at the corner of the mouth with 2cm wide zinc oxide (see pictures below). Please ensure that as little 'give' is present as possible to minimise excessive tube movement.

				
Place Duoderm patches onto cheeks and a strip on the upper and lower lips	Cut 2 pieces 6 cm in length of 2cm wide zinc oxide tape, cut each to midway.	Apply the 'block' of tape to the cheek and one leg to the upper lip. Wrap the other leg around the ETT.	Apply the 'block' of tape to the cheek and one leg to the lower lip. Wrap the other leg around the ETT.	Ensure there is not excessive movement of the ETT. If there is, re-secure the tube.

#### If the infant requires intubation:

- Ensure appropriate analgesia and muscle relaxant are given prior to intubation.
- Commence maintenance regimen of morphine in 10% glucose.
- To minimize skin damage apply Cavilon to the cheeks and upper and lower lips, allow to dry for at least 1 minute before applying Duoderm patches to the cheek areas and a strip on the upper and lower lips.
- Using the trouser fixation method, secure the ETT with zinc oxide.

#### If the infant does not require intubation:

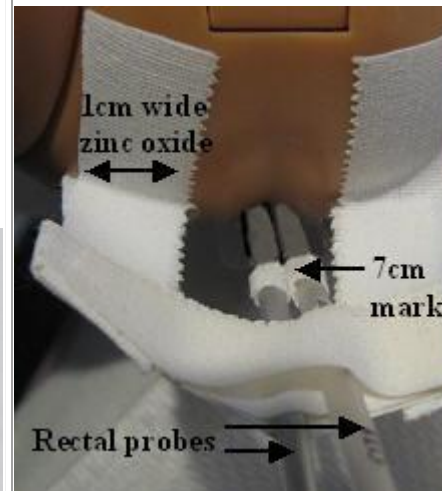
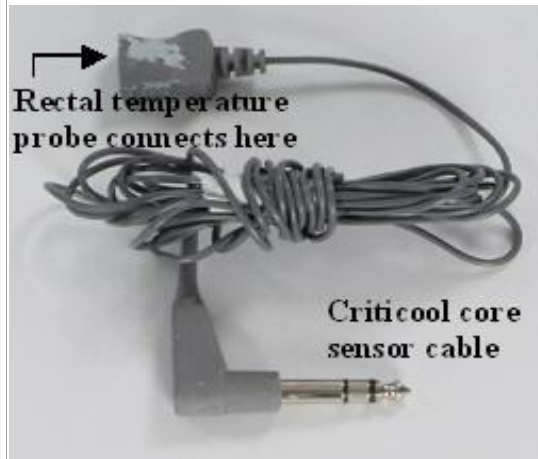
- Infant should receive a loading dose of morphine followed by a morphine infusion.
- Monitor respiratory effort and blood pressure as this may cause reduced respiratory effort and the baby may require intubation.

#### The infant then requires:

##### Step1

1 rectal temperature probes (this must be in place before cooling is started):

- wipe Cavilon swabs over the buttocks to limit skin damage,
- mark temperature probe at 7cm with a small piece of zinc oxide tape wrapped around probe,
- using lubricant, insert the probe to 6cm,
- secure the probe with 1cm wide zinc oxide tape
- Ensure the rectal probe is connected to the grey cable which should be inserted into the core port on the front of the criticool machine. The core out cable can then be attached to the phillips attachment, allowing the core temperature reading to be displayed on the phillips monitor.



Rectal temperature probe

The rectal temperature probe is connected to grey cable.

Rectal temperature probe fixation method. (Please note **only one rectal probe** is now required)

## Step 2

Apply body wrap:

- Position the body wrap with the soft side on the bed, the 'rough' side is the side which the baby will lie on. Lie baby centrally on the the pre-filled wrap.
- Bring the wrap edges together over trunk with open V over umbilicus for observation of lines
- Bring the wrap edges around legs and secure
- The infant's head should lie on the wrap but the sides must not be folded around the head.
- Place a beanie or soft cushioning between the infant's head and the body wrap (see picture).



For 'cooling' baby will be naked except for a nappy

### Step 3

- A double lumen UVC & UAC or peripheral arterial line
- A peripheral temperature probe to foot. This will be used to judge changes in toe core gap; it must not be used to introduce 'warming up' techniques.

The wrap may be opened to allow:

- Aseptic insertion of lines ensuring that iodine does not contaminate the ThermoKool
- Insertion of urinary catheter

When taking an X-ray.

- The wrap must be opened and the X-ray plate positioned directly between baby and the wrap.

### Supportive nursing

#### Ventilation

- Humidified and heated gas is used as normal.
- More frequent ET suction may be required, as secretions tend to be stickier when cold particularly on the last day of cooling.
- Muscle relaxant – Can be given if required to assist optimal ventilation.
- Blood gases should be kept within target values.

#### Positioning

- Position changes should be done 6 hourly with cares. If there is concern over skin integrity this can be increased to 4 hourly. Appropriate positions are supine and 30° tilt right or left side.
- Do not turn the head alone, it should always be kept in midline with the body to avoid impairment of cerebral blood flow return.
- During the last 24hrs of cooling it may be necessary to change the position more frequently as secretions may be more problematic.

### Skin Integrity

- The infant's skin must be inspected 6 hourly. The body wrap is unfastened, the skin inspected and the wrap quickly re-applied. Normal nappy area hygiene should be carried out; if meconium is passed, it is essential to wipe it away but do not remove zinc oxide or Thermawrap if contaminated with stool.

### Analgesia

- Most infants will be ventilated during hypothermia. Morphine will be given as an analgesic/sedative. Assessment of comfort should be carried out with routine cares. It is important that infants do not experience pain or distress during cooling and for this reason may have to be sedated heavily.

### Observations

- Hourly observations will be carried out and recorded - HR, RR, oxygen saturation, invasive BP and temperature - peripheral [T2] and rectal probe.
- HR is a good indicator of adequate analgesia/sedation. HR changes by 14bpm per 1°C change in temperature. At temperature of 33.5°C the average HR is 90bpm.
- An increased HR despite hypothermia can be seen if: baby is too awake, stressed, in pain, is hypovolaemic, is hypotensive or on inotropes.
- Hypothermia should not adversely affect BP or oxygen saturation.
- Rectal temperature should be maintained at 33.5°C +/- 0.5.
- Shivering is common during hypothermia and should be suppressed with increased sedation. Shivering is also common during and after re-warming and can be eased by swaddling or covering the baby with a light sheet.

### Monitor limits

Phillips monitor alarm limits:

- HR limits may be lowered to accommodate the natural lowering of the infant's heart rate i.e. if the HR is around 90 bpm the lower and upper limits may be set at around 80 and 110bpm
- Rectal temperature limits must be set within +/- 0.5°C of target rectal temperature i.e. if the desired rectal temperature is 33.5°C the lower and upper limits should be set at 33°C and 34°C

### Fluids

- May be restricted (40-60ml/kg/day). Sodium levels tend to fall and can be replaced as prescribed but tend to be kept on the low side prior to re-warming as hypernatraemia often occurs.
- Hypoglycaemia may occur particularly from day 2 of cooling and should be corrected.
- Catheter/cannula site must be inspected as per normal practice; skin perfusion should be as with a non-hypothermic infant.

### Fluid balance

- Urine output should be measured and recorded 6 hourly, specific gravity and urinalysis should be carried out with each measurement.

### Nutrition

- Small amounts of EBM may be given during cooling as trophic feeds. Weaning of EBM or formula milk should only be started once baby is re-warmed.

## Re-warming

- Re-warming starts 72 hours from the time when core temperature was first reached ie 33.5°C (note this time may be different to when criticool jacket was applied or the time baby was admitted to hospital).
- It is essential that both invasive BP and CFAM monitoring are continued and attention is paid to any small deviation as it is common to become hypotensive or for seizures to occur at this time. If either of these occur, medical staff must be alerted immediately and re-warming may be continued more slowly or halted.
- Re-warming should be done very slowly with half hourly increase in temperature of 0.2°C. Set the timer to alarm every 30 minutes when re-warming. The machine reaches the new set temperature within 30 minutes, it is therefore essential to only increase the machine by 0.2°C every 30 minutes to avoid re-warming too quickly.
- Each change in the machine temperature setting must be recorded on the 24 hour observation chart. This regimen should continue until the desired temperature of 36.8°C is achieved.
- Following re-warming to 36.8°C, the Criticool machine and jacket will be used to maintain the desired temperature for a further 24 hours. Rectal probe must stay in situ.
- Once the baby has had a temperature of around 36.8°C for 18 hours, the radiant heater should be turned on and set to 35.5°C so that the infant's temperature does not fall once the jacket is removed after a further 6 hours (total 24 hours with temperature maintained at 36.8°C in Criticool jacket). Once the jacket is removed adjust the radiant heater temperature to maintain baby temperature between 36.5-37.3°C thereafter.
- Rectal probe should be kept in situ for a further 24 hours after normothermia has been established but may be removed and not replaced if baby is undergoing a MRI.
- Rebound hyperthermia is relatively common after cooling and must be treated with paracetamol.

## Suggested target values during hypothermia

- Rectal temperature 33.5°C +/- 0.5°C (preferably less variability than 0.5°C)
- Mean arterial blood pressure 45- 65 mmHg
- Oxygen saturation (SaO<sub>2</sub>) 92- 98%
- PCO<sub>2</sub> 5- 7 kPa
- PO<sub>2</sub> 6- 10 kPa
- Heart rate 80-100bpm
- Electrolytes, within normal range - Note that Magnesium (Mg) should preferably be > 1.0mmol/l.
- Glucose, within normal range.
- Lactate, within range for condition. Hypothermia does not affect lactate or pH.

## Potential Complications

Drug accumulation and over sedation, blocked ETT, hyponatraemia and fluid overload, seizures and hypotension, skin breakdown and bleeding.

If rectal temperature probe dislodges this can result in an inadequate consistent cooling temperature.