

Hypoxic-ischaemic encephalopathy (HIE)

Clinical Guideline Presentation v3.0



45 minutes

Towards your CPD Hours

References:

The Queensland Clinical Guideline *Hypoxic-ischaemic encephalopathy (HIE)* is the primary reference for this package.

Recommended citation:

Queensland Clinical Guidelines. *Hypoxic-ischaemic encephalopathy (HIE)* clinical guideline education presentation E16.11-1-V3-R21. Queensland Health. 2018.

Disclaimer:

This presentation is an implementation tool and should be used in conjunction with the published guideline. This information does not supersede or replace the guideline. Consult the guideline for further information and references.

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Abbreviations

aEEG	Amplitude-integrated electroencephalograph	NNST	Newborn screening test
APTT	Activated partial thromboplastin time	NNT	Number needed to treat
BGL	Blood glucose levels	QCG	Queensland Clinical Guideline
BP	Blood pressure	RR	Respiration rate
CSCF	Clinical Services Capability Framework	RSQ	Retrieval Services Queensland
EEG	Electroencephalograph	SpO₂	Peripheral capillary oxygen saturation
FBC	Full blood count	TH	Therapeutic hypothermia
HIE	Hypoxic-ischaemic encephalopathy	>	Greater than
HR	Heart rate	<	Less than
INR	International normalised ratio for blood clotting	≥	Greater than or equal to
MRI	Magnetic resonance imaging	≤	Less than or equal to
NEC	Necrotising enterocolitis		

Objectives

At the end of this presentation, the participant will be able to outline:

- Care of the baby with suspected hypoxic-ischaemic encephalopathy (HIE)
- Criteria for commencing therapeutic hypothermia
- Prognostic tools utilised in assessing probable long term outcome
- Discharge planning considerations
- Parental considerations and information

Introduction

- An acute peripartum or intrapartum event

Can lead to

- Systemic hypoxaemia and/or
- Reduced blood flow

Can result in

- HIE

and

- The potential for significant mortality and long-term morbidity

Incidence

- Queensland 2007–2012:
 - Intrauterine hypoxia and birth asphyxia: 4–6 per 1000 live preterm and term births (not all of these babies developed HIE)
- Overseas countries:
 - Term intrapartum hypoxia-ischaemia is 3.7 (range 2.9–8.3) per 1000 term births
 - HIE is 2.5 per 1000 live births



Ref: Bliss, BeBop. HIE (Hypoxic-ischaemic encephalopathy) information for parents. 1st edn (2012)



Parental considerations

- Ensure regular discussions and meetings
- Shared decision making
- Facilitate involvement in care:
 - Explanation of tests, procedures, drugs, equipment, pain management
 - Dependent on the baby's condition, assist parents to provide care measures
- Refer to local support services and provide parent information
- If required, provide palliative and bereavement care



<http://www.aboutkidshealth.ca/en/resourcecentres/pregnancybabies/newbornbabies/caringforthevervill/newbornbaby/babies/palliative-care.aspx>

The hospital for sick children

Diagnosis: intrapartum events

- An absence of an intrapartum sentinel event does not exclude the diagnosis of HIE
- Events which may precede HIE include:
 - A significant peripartum or intrapartum hypoxic-ischaemic event including:
 - Uterine rupture
 - Placental abruption
 - Cord prolapse
 - Amniotic fluid embolism
 - Fetal exsanguination from a vasa praevia or massive feto-maternal haemorrhage

Diagnosis: intrapartum events

- A normal fetal heart rate pattern that changed to:
 - Sinusoidal pattern
 - Absent baseline variability with recurrent late or variable decelerations, or bradycardia
 - Another fetal heart rate pattern such as tachycardia with recurrent decelerations or persistent minimal variability with recurrent decelerations
 - Refer to QCG: *Intrapartum fetal surveillance*



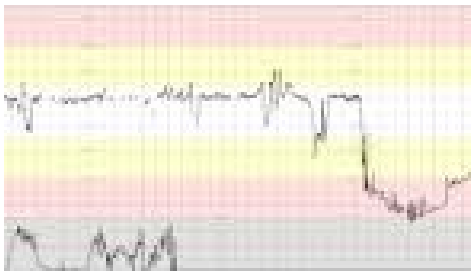
Diagnostic criteria

- No clear diagnostic test: assess for features suggestive of a hypoxic and/or ischaemic injury during the perinatal and/or intrapartum period:
 - Fetal umbilical artery acidaemia: pH < 7.0 and/or base excess equal or worse than minus 12 mmol/L
 - Examination consistent with mild, moderate or severe encephalopathy
 - Onset of multisystem organ failure which may include a combination of renal injury, hepatic injury, hematologic abnormalities, cardiac dysfunction, metabolic derangements, and gastrointestinal injury

Diagnosis: clinical staging

- Originally described by Sarnat and Sarnat, 1976; since modified
- Provides information on magnitude of injury and prognosis
- Seizures often associated with moderate and/or severe stages

Category	Encephalopathy		
	Mild	Moderate	Severe
Level of consciousness	Hyperalert, irritable	Lethargic	Stupor or coma
Spontaneous activity	Excessive crying or sleepiness	Decreased activity	No activity
Posture	Mild distal flexion	Distal flexion, complete extension	Decerebrate
Tone	Normal or slightly increased	Hypotonia (focal or general)	Flaccid
Primitive reflexes	Weak suck, strong Moro	Weak suck or incomplete Moro	Absent suck or Moro
Autonomic system	Dilated pupils, tachycardia	Constricted pupils, bradycardia or periodic/irregular breathing	Deviated/dilated/non-reactive pupils, variable heart rate or apnoea



Resuscitation

- Aim for normothermia until the baby meets the inclusion criteria for therapeutic hypothermia
- Measure cord blood gases
- Ensure a capillary, venous or arterial blood gas is taken within the first hour following birth
- Refer to QCG: *Neonatal resuscitation*



<http://www.ablawcenters.com/frequently-asked-questions/michigan-hie-lawyers-what-is-hypoxic-ischemic-encephalopathy/>

Observation and monitoring

If there is evidence of acute perinatal/intrapartum hypoxia ischaemia as suggested by at least one of the following:

- ❑ Apgar score ≤ 5 at 10 minutes
- ❑ The blood gas (cord/arterial/venous/capillary) within 60 minutes of birth includes either a:
 - ❑ pH < 7.00 , or
 - ❑ Base excess equal to or worse than minus 12 mmol/L
- ❑ Mechanical ventilation or ongoing resuscitation for ≥ 10 minutes



Commence:

- Continuous monitoring: HR, RR, and SpO₂
- Hourly (or more frequent) documented observations, including:
 - Temperature: avoid hyperthermia (> 37.5 °C)
 - BP
 - HIE staging criteria

- Babies who are likely to meet the criteria for therapeutic hypothermia: initiate early discussion with a neonatologist
- CSCF Level 1-5 Neonatal service:
 - Contact RSQ: 1300 799127
 - Refer to QCG: *Neonatal stabilisation for retrieval*

Multi-organ considerations

Aspect	Consideration
Respiratory	<ul style="list-style-type: none">• Avoid hyperoxia and hypocapnia
Cardiovascular	<ul style="list-style-type: none">• Hypotension, shock, cardiomegaly, arrhythmias, heart failure or ischaemia may occur
Neurological	<ul style="list-style-type: none">• Assess for encephalopathy• Refer to QCG: Neonatal seizures
Renal	<ul style="list-style-type: none">• Oliguria, haematuria, proteinuria, myoglobinuria, polyuria or renal failure may occur—monitor fluid balance
Metabolic	<ul style="list-style-type: none">• Hypo/hyperglycaemia, hypocalcaemia, hyponatraemia, hypomagnesaemia, lactic acidosis may occur• Maintain BGL within normal ranges
Haematology	<ul style="list-style-type: none">• Thrombocytopenia, thrombosis, elevated nucleated red blood cells may occur
Gastrointestinal	<ul style="list-style-type: none">• The baby is at risk for necrotising enterocolitis
Infection	<ul style="list-style-type: none">• May co-exist with HIE• Refer to QCG: Early onset Group B streptococcal disease

Investigations

Investigations

Routine

- Blood gases, electrolytes, glucose and lactate (all obtainable from blood gas sample)
- FBC including platelets
- INR and APTT clotting studies
- Liver and renal function: day 1–2
- Septic work-up
- The above may need to be repeated (e.g. daily or more often) if abnormal or if there is ongoing moderate or severe encephalopathy or signs of dysfunction of other organs (e.g. oliguria)
- MRI: day 7 (5–10)

Additional

- In moderate to severe HIE: commence continuous aEEG (if available) for 96 hours (or EEG, ideally accompanied by video) in order to confirm clinical seizures and detect subclinical seizures and provide prognostic value

Differential diagnosis investigations

- To exclude other causes of neonatal encephalopathy consider:
 - Lumbar puncture
 - Blood for chromosome analysis, ammonia, amino acids
 - Urine for amino and organic acids, ketones, reducing substances
 - NNST if metabolic/genetic disorders suspected. Repeat NNST when it would normally have been collected
 - Cranial ultrasound: day 1

Therapeutic hypothermia (TH)

- Compared to no treatment, therapeutic hypothermia is associated with a reduction of:
 - 48% in death or major neuro-developmental disability
 - 27% in mortality
 - 28% in major neuro-developmental disability
- NNT to reduce combined outcome of mortality or major neuro-developmental disability at 18 months of age was 7

Jacobs SE, Berg M, Hunt R, Tarnow-Mordi WO, Inder TE, Davis PG. Cooling for newborns with hypoxic ischaemic encephalopathy. Cochrane Database of Systematic Reviews. 2013; Issue 1.Art.No.:CD003311.DOI: 10.1002/14651858.CD003311.pub3:CD003311.

Inclusion criteria

Aspect	Criteria
Inclusion criteria	<ul style="list-style-type: none">• Evidence of perinatal/intrapartum hypoxia, as indicated by at least one of the following:<ul style="list-style-type: none">○ Apgar score ≤ 5 at 10 minutes○ Needing mechanical ventilation or ongoing resuscitation at 10 minutes○ pH < 7.00 or a base excess equal to or worse than minus 12 mmol/L on a cord/arterial/venous/capillary blood gas obtained within 60 minutes of birth• Either seizures or 3 other symptoms associated with moderate/severe encephalopathy• ≥ 35 weeks gestational age• Birth weight ≥ 1800 g• Able to begin cooling before 6 hours of birth
Relative contra-indications	<ul style="list-style-type: none">• Major congenital abnormalities• Uncontrolled pulmonary hypertension• Critical bleeding or coagulopathy• So severely affected that there is little hope for normal outcome

TH: standards and clinical practice

- Commence within 6 hours of birth
- Cool for 72 hours
- Target core temperature of 33–34.0 °C
- Commence passive cooling and continuous core (rectal) temperature monitoring if available or
 - 20 minute recording of axilla temperature
- Nurse baby wearing nappy only and on an open care system cot with radiant warmer turned off
- Gain venous access: preferably umbilical
- Insert arterial catheter at a Level 5 or 6 neonatal unit

TH: clinical practice

- Initiate active cooling:
 - Servo-controlled cooling and rewarming mattress: preferred method
 - Manual: cool packs (guide 10 °C)
 - Observe skin 15 minutely: be alert for subcutaneous fat necrosis
- Metabolism of most drugs will be altered:
 - Potential for accumulation and toxicity
- Withhold enteral feeds due to the risk of NEC
- Other risks: thrombocytopaenia, sinus bradycardia (reversible with warming)
- Rewarming: will take 12–16 hours



<http://www.valleychildrens.org/PressRoom/HospitaINews/Pages/CoolingBlanket.aspx>



Prognosis



http://raisingchildren.net.au/articles/cerebral_palsy.html/context/1303

- Early prognosis of long term outcome is difficult
- Rather than any single method, prognosis is best determined by using multiple modalities:
 - Clinical assessment and neurological examination
 - aEEG and/or EEG
 - MRI
 - Dubowitz and general movements assessment

Follow-up

- Plan a discharge and follow-up meeting with the parents
 - Discuss what happened to their baby, treatments and ongoing follow-up
 - Provide written information
- Moderate to severe HIE:
 - Provide follow-up for at least 2 years
 - Ensure appropriate assessment and referrals
 - Data collection on outcomes



Follow-up

- If the baby has died:
 - Discuss the purpose and/or value of an autopsy with the parent(s)
 - Suggest and refer parents to adequate support personnel for emotional/psychological support
 - Discuss and refer to the Coroner as required