Hypoxic-ischaemic encephalopathy (HIE)

Clinical Guideline Presentation

45 minutes

Towards CPD Hours

Clinical Excellence Queensland

Queensland Government

References:

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 E21.11-1-V4-R26. Queensland Health. 2021.

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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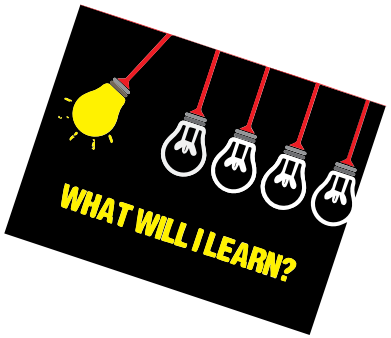
Objectives



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
- Discharge planning considerations
- Parental considerations and information

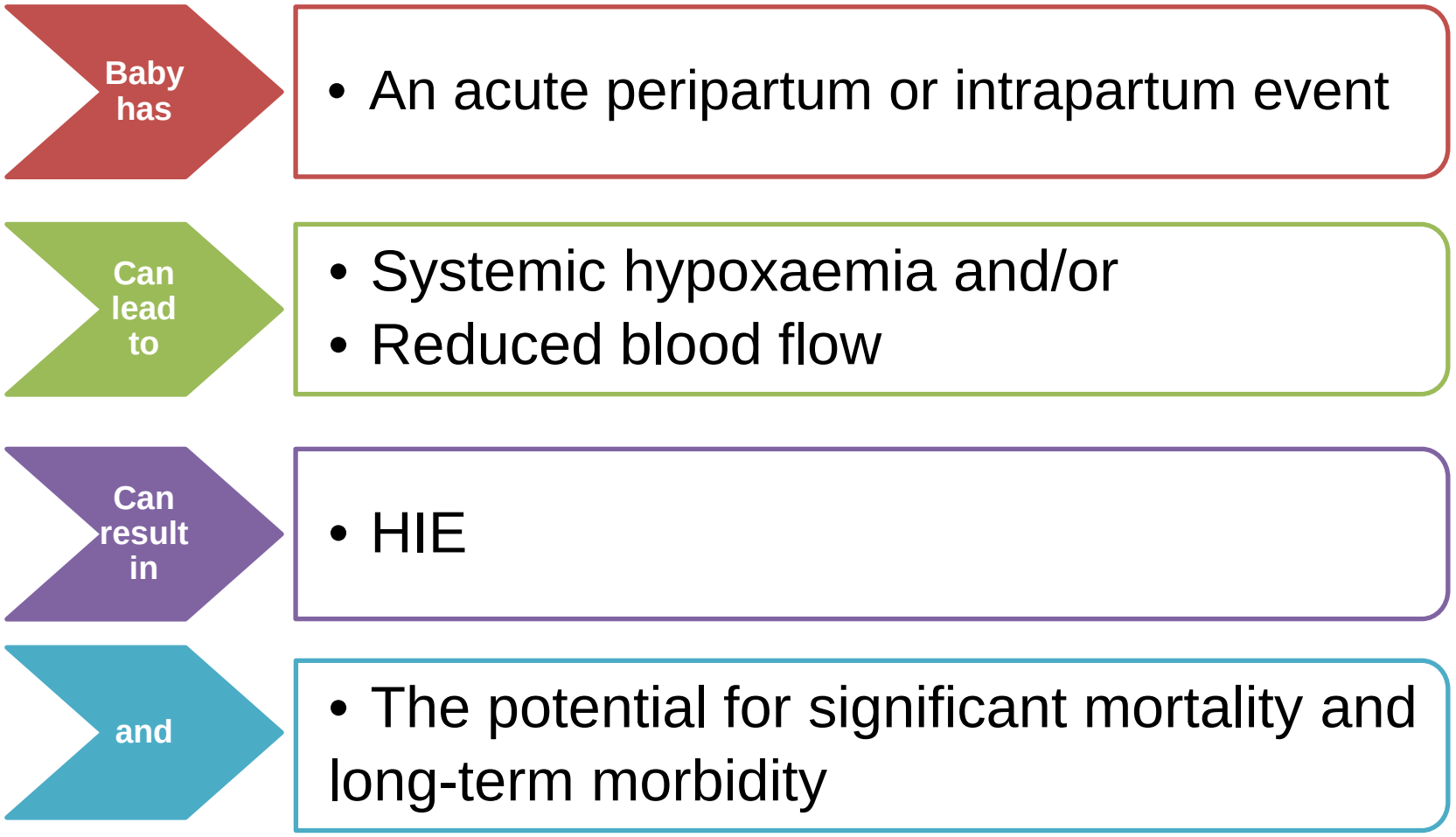
Abbreviations

aEEG	Amplitude-integrated electro-encephalograph
APTT	Activated partial thromboplastin time
BGL	Blood glucose levels
BP	Blood pressure
CSCF	Clinical Services Capability Framework
FBC	Full blood count
FGR	Fetal growth restriction
GDM	Gestational diabetes mellitus
HIE	Hypoxic-ischaemic encephalopathy
HR	Heart rate
INR	International normalised ratio
LoC	Level of consciousness
LP	Lumber puncture

Abbreviations

MRI	Magnetic resonance imaging
NBST	Newborn bloodspot screening test
NEC	Necrotising enterocolitis
QCG	Queensland Clinical Guideline
RR	Respiration rate
RSQ	Retrieval Services Queensland
SpO_2	Peripheral capillary oxygen saturation
TH	Therapeutic hypothermia
>	Greater than
<	Less than
≥	Greater than or equal to
≤	Less than or equal to

Introduction



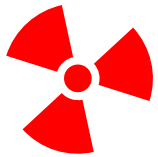
Incidence

- Queensland 2015–2019:
  - Intrauterine hypoxia and birth asphyxia 1.3–1.7% of all live preterm and term births (not all of these babies developed HIE)
- Internationally:
  - Term intrapartum hypoxia-ischaemia is 3.7 (range 2.9–8.3) per 1000 term births
  - HIE is 2.5 per 1000 live births

Parents and family

- Regular discussions and meetings
  - Explanation of tests, procedures, drugs, equipment, pain management
- Assist parents to provide care measures (depending on baby's condition)
- Refer to local support services and provide parent information
- If required, provide palliative and bereavement care

Risk factors



Aspect	Examples
Maternal	Thyroid disease, hypertension, GDM, infection, uterine rupture, birthing complications
Fetal/baby	FGR, low Apgar scores
Feto-placental	Multiple pregnancy, oligohydramnios, polyhydramnios
Intrapartum events	Prolonged shoulder dystocia, abnormal fetal heart rate pattern

Resuscitation

- 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
- Refer to QCG: *Neonatal resuscitation*

Diagnosis

- Significant peripartum or intrapartum hypoxic-ischaemic events include:
  - Uterine rupture
  - Placental abruption
  - Cord prolapse
  - Amniotic fluid embolism
  - Fetal exsanguination from vasa praevia or massive feto-maternal haemorrhage

Diagnosis

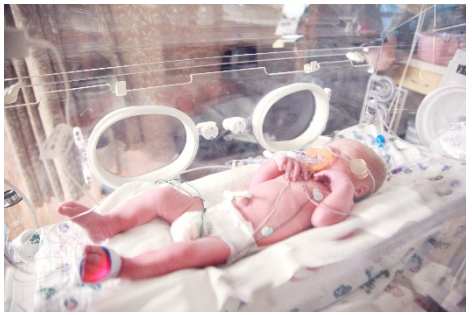
- No biomarker
- May have history of hypoxic and/or ischaemic injury during the perinatal and/or intrapartum period
- Absence of intrapartum sentinel event does not exclude the diagnosis of HIE

Clinical features

- Abnormal state of consciousness
- Reduced spontaneous movements
- Respiratory difficulties
- Poor tone
- Abnormal posturing
- Abnormal primitive reflexes
- Seizures
- Poor feeding

Diagnostic criteria

- Fetal umbilical artery acidaemia
  - pH < 7.0 and/or base deficit ≤ minus 12 mmol/L
- Examination
  - Consistent with mild, moderate or severe encephalopathy



Diagnostic criteria (cont'd)

- Onset of multisystem organ failure may include a combination of
  - Renal injury
  - Hepatic injury
  - Haematologic abnormalities
  - Cardiac dysfunction
  - Metabolic derangements
  - Gastrointestinal injury

Investigations

- Routine–repeat daily or more often
  - Blood gas
  - Electrolytes, calcium, glucose and lactate
  - FBC including platelets
  - Coagulation profile–INR and APTT
  - Septic work-up–blood culture, LP
  - Liver and renal function: day 1–2
  - MRI at day 5–10
- If moderate/severe HIE– aEEG if available

Differential diagnosis

- Consider other causes of encephalopathy, for example:
  - Metabolic abnormalities
  - Congenital abnormalities
  - Meningitis
  - Hypoglycaemia
  - Hyperbilirubinaemia
  - Chronic placental insufficiency
  - Other causes of newborn seizures/encephalopathy e.g. intracranial haemorrhage, perinatal stroke, drug withdrawal

Observation and monitoring

If acute perinatal/intrapartum hypoxia ischaemia as evidenced by:

- ❑ Apgar score ≤ 5 at 10 minutes
- ❑ Blood gas either:
  - ❑ pH < 7.00, or
  - ❑ Base excess ≤ minus 12 mmol/L
- ❑ Mechanical ventilation or ongoing resuscitation for ≥ 10 minutes

Commence:

- Continuous monitoring:
  - HR, RR and SpO_2
  - BP (if manual 15 minutely)
- Hourly (or more frequent:
  - Temperature: avoid hyperthermia (> 37.5 ^{o}C)
  - HIE staging criteria

Discuss eligibility for TH with neonatologist

Clinical staging of HIE

- Modified Sarnat and Sarnat scoring
  - Provides information on magnitude of injury and prognosis
  - Commence as soon as possible after resuscitation and stabilisation
  - Continue for at least first six hours
  - Baby may deteriorate and move from stage 1 (mild) to stage 2 (moderate)
- Discuss with neonatologist

HIE clinical staging

Category	Mild (Stage 1)	Moderate (Stage 2)	Severe (Stage 3)
LoC	Hyperalert	Lethargic	Stupor or coma
Spontaneous activity	Normal or increased	Decreased	None
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	Pupils equal and reacting to light; tachycardia	Constricted pupils, bradycardia or periodic/irregular breathing	Deviated/dilated/ non-reactive pupils, variable heart rate or apnoea
Seizures	None	Common, focal or multifocal	Uncommon

Therapeutic hypothermia criteria

- Evidence of perinatal/intrapartum hypoxia:
  - Apgar score ≤ 5 at 10 minutes
  - Ongoing resuscitation at 10 minutes
  - pH < 7.00 or a base deficit ≤ minus12 mmol/L on blood gas within 60 minutes of birth
- Evidence of encephalopathy **at any time in first 6 hours**
- Signs associated with moderate/severe encephalopathy
- ≥ 35 weeks gestational age and birth weight ≥ 1800 g
- Able to begin cooling before 6 hours of birth
- No contraindication, e.g. uncontrolled bleeding, uncontrolled hypoxia, imminent withdrawal of life support planned
- If mild encephalopathy, < 35 weeks or < 1800 g discuss with neonatologist

Therapeutic hypothermia–stabilisation

If baby likely to meet TH criteria:

- Refer to QCG: *Neonatal stabilisation for retrieval*
  - Contact RSQ as required
- Nurse baby with nappy only on open care cot with radiant warmer off
- Insert venous access and nasogastric tube
- Collect blood samples

Therapeutic hypothermia–clinical standards

- Commence within 6 hours of birth before secondary reperfusion injury
- Cool for 72 hours at target temperature
- Target core temperature of 33–34.0 ^{o}C within 2 hours
- Continuous core (rectal) temperature monitoring (if available) or axilla temperature every 30 minutes

Therapeutic hypothermia– clinical practice

- Passive cooling:
  - Open care system with radiant warmer off
  - Nappy only on baby
- Active cooling:
  - Servo-controlled and rewarming mattress (preferred)
  - Manual using covered cool packs (10 ºC)– observe for skin necrosis

Therapeutic hypothermia–clinical practice

- NBM–risk of NEC
- Sedation/pain relief–low dose morphine
- Monitor medications as metabolism of most drugs altered
- Monitor for thrombocytopaenia, sinus bradycardia

Multi-organ considerations

Aspect	Consideration
Respiratory	• Avoid hyperoxia and hypocapnia • Maintain SpO_2 ≥ 92%
Cardiovascular	• Hypotension, shock, cardiomegaly, arrhythmias, heart failure, ischaemia may occur • Avoid hypertension or hypotension
Infection	• May co-exist with HIE • Commence empirical antibiotics • Refer to QCG: *Early onset Group B streptococcal disease*
Neurological	• Assess for encephalopathy • Manage seizures • Refer to QCG: *Neonatal seizures*
Neuro-development	• Reduce environmental stimuli • Manage pain, stress and comfort • Involve parents

Multi-organ considerations

Aspect	Consideration
Renal	• Oliguria, haematuria, proteinuria, myoglobinuria, polyuria or renal failure may occur • IV fluids and monitor fluid balance
Metabolic	• Hypo/hyperglycaemia, hypocalcaemia, hyponatraemia, hypomagnesaemia, lactic acidosis may occur • Maintain BGL within normal ranges • Refer to QCG: *Newborn hypoglycaemia*
Haematology	• Thrombocytopenia, thrombosis, elevated nucleated red blood cells may occur • Perform coagulation profile
Gastrointestinal	• Risk of NEC • NBM

Rewarming after TH

- Rewarm over 12–16 hours at 0.5 ºC every 2 hours
- Monitor rectal temperature for 6 hours after return to normal
- Monitor for apnoea, hypotension, seizures

Prognosis

- Early prognosis of long term outcome is difficult–best determined by using multiple modalities
  - Clinical assessment
  - Neurological examination
  - aEEG and/or EEG
  - MRI

Follow-up

- Plan a discharge and follow-up meeting with the parents
  - Discuss what happened to their baby, their treatment and ongoing follow-up
  - Provide written information
- Moderate to severe HIE:
  - Provide follow-up for at least 2 years
  - Ensure appropriate assessment and referrals
- Mild HIE–consider follow up also