HYPOXIC ISCHAEMIC ENCEPHALOPATHY

DEFINITION
Lack of sufficient oxygen to the brain and a diminished amount of blood perfusing the brain, resulting in suppression of electrical activity and cortical depression.

EPIDEMIOLOGY
Intrapartum hypoxia affects 1-2 infants per 1000 live term births. Moderate to severe encephalopathy affects 0.5 -1 per 1000 live births. 20% are due to antenatal events, 35% due to intrapartum events, 35% due to antenatal & intrapartum events, and 10% postnatal (higher in preterm babies). However, neonatal encephalopathy can be present without evidence of hypoxia or ischaemia at birth.

PATHOPHYSIOLOGY
Following a hypoxic-ischaemic insult, neuronal death can occur in two ways:

- **Primary neuronal death** - immediate death if the insult is severe. This is related to cellular hypoxia leading to primary energy failure and cellular depolarisation.

- **Secondary phase** - after a latent period (at 6 -100 hours) neuronal death may be initiated by a cascade of pathologic processes and is associated with marked encephalopathy. This involves cytotoxic oedema, mitochondrial failure, accumulation of excitotoxins, active cell death, nitric oxide synthesis and cytotoxic actions of activated microglia. Seizure activity is increased during this phase.

CLINICAL PRESENTATION
There may be evidence of other end-organ damage such as coagulopathy, raised liver enzymes, acute renal failure, hypotension, persistent fetal circulation and/or respiratory failure.

INVESTIGATIONS
- Neurological examination.
- Blood tests to exclude other organ function - Blood gases, FBC, coagulation profile, liver enzymes, urea and creatinine, glucose, electrolytes (including Ca, Mg, and PO₄), lactate.
- Brainz monitor / EEG if seizures are evident.
- Lumbar puncture if sepsis suspected
- Head Ultrasound ± CT scan or MRI.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Stage III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of consciousness</td>
<td>Alert</td>
<td>Lethargic</td>
<td>Comatose</td>
</tr>
<tr>
<td>Muscle tone</td>
<td>Normal or hypertonic</td>
<td>Hypotonic</td>
<td>Flaccid</td>
</tr>
<tr>
<td>Tendon reflexes</td>
<td>Increased</td>
<td>Increased</td>
<td>Depressed or absent</td>
</tr>
<tr>
<td>Myoclonus</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Seizures</td>
<td>Absent</td>
<td>Frequent</td>
<td>Frequent</td>
</tr>
<tr>
<td>Complex reflexes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suck</td>
<td>Active</td>
<td>Weak</td>
<td>Absent</td>
</tr>
<tr>
<td>Moro</td>
<td>Exaggerated</td>
<td>Incomplete</td>
<td>Absent</td>
</tr>
<tr>
<td>Grasp</td>
<td>Normal to exaggerated</td>
<td>Exaggerated</td>
<td>Absent</td>
</tr>
<tr>
<td>Oculocephalic (doll eye)</td>
<td>Normal</td>
<td>Overactive</td>
<td>Reduced or absent</td>
</tr>
<tr>
<td>Auotonic function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pupils</td>
<td>Dilated, reactive</td>
<td>Small, reactive</td>
<td>Variable/fixed</td>
</tr>
<tr>
<td>Respiration</td>
<td>Regular</td>
<td>Periodic</td>
<td>Ataxic, apneic</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal or tachycardia</td>
<td>Bradycardia</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>EEG</td>
<td>Normal</td>
<td>Low voltage, periodic, or paroxysmal</td>
<td>Periodic or isoelectric</td>
</tr>
</tbody>
</table>

**PROGNOSIS**
- Mild (stage I): all survive and are normal.
- Moderate (stage II): 5% die, 20% with neurological sequelae.
- Severe (stage III): 75% die, 90 -100% with neurological sequelae.

**MANAGEMENT**
This is dependent on the extent of organ failure.

1. **TEMPERATURE CONTROL.**

Evidence from high quality RCTs indicates that cooling of neonates with moderate to severe HIE is safe and reduces the risk of death or disability at 18 to 22 months of age.

Therefore, cooling is the first intervention which has been proven in rigorously conducted scientific studies to be beneficial in term & near term neonates with HIE.

Please see guideline on Systemic Cooling for Neuroprotection in Neonates ≥35 weeks gestational age with Hypoxic Ischaemic Encephalopathy (HIE)

2. **AVOID HYPOGLYCAEMIA**

The blood sugar is often transiently elevated immediately after asphyxia, often followed by hypoglycaemia.

To prevent secondary hypoglycaemia
- Provide 6-8mg/kg/min of glucose infusion IV and Check PGLs hourly for the first 4 hours.
- Increase concentration of dextrose to maintain above Glucose Infusion Rate, if fluid restriction required.
- If PGLs maintained well above 2.6 mmmol/L frequency of checking may be reduced, but should remain at least 4 hourly for the first 24hours. (see hypoglycaemia guideline.)
3. **APPROPRIATE MANAGEMENT OF ASSOCIATED PROBLEMS**
   Sepsis (see infection section).

4. **FLUID RESTRICTION**
   40 – 50ml/Kg/day.

5. **RESPIRATORY SUPPORT**
   May be needed for poor self ventilation, seizures, etc.

6. **BLOOD PRESSURE SUPPORT**
   Volume expansion or Inotrope may be required. The infant should remain normotensive to maintain cerebral perfusion pressure but not too high to prevent reperfusion injury.

7. **SEIZURE CONTROL (SEE SEIZURES)**

8. **FOLLOW-UP**
   All infants showing signs of HIE require appropriate follow-up.

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**REFERENCES**