Scope
This guideline is aimed at all Health care professionals involved in the care of infants within the Perinatal Directorate.

Key points
- Continuous insulin infusions can achieve glycaemic control, increased caloric intake and weight gain especially in extremely low birth weight infants.\(^1,2\)

Aims
1. To identify and treat underlying aetiology (e.g infection, hypoxia, stress response, pain, medications and parenteral glucose overload).
2. To prevent complications of hyperglycaemia (fluid and electrolyte imbalance)
3. To maintain euglycaemia (5-7 mmol/L) and adequate caloric intake without causing hypoglycaemia.

Related UHL documents:

<table>
<thead>
<tr>
<th>Insulin, Soluble: Neonatal Drug Monograph</th>
<th>C63/2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Use of Insulin on the Neonatal Unit</td>
<td>C25/2006</td>
</tr>
</tbody>
</table>

Background
There is no established definition of neonatal hyperglycaemia. However blood sugar levels > 12mmol/L accompanied by severe (3+) glycosuria may warrant treatment especially in sick preterm infants. However preterm babies have a low renal threshold for glucose and glycosuria may be present even with normoglycaemia. Hyperglycaemia may herald a serious underlying disorder such as infection and has the potential for an osmotic diuresis and resultant dehydration. There is also theoretical risk of cerebral damage due to changes in blood osmolality and fluid shifts. Unlike adults with insulin deficiency, neonatal hyperglycaemia is transient with absence of ketosis and metabolic acidosis.
Flowchart for the management of neonatal hyperglycaemia

Hyperglycaemia (infant mostly on IV/PN)
(Blood glucose > 9mmol/L on two occasions at least 2 hours apart)

- Investigate and treat underlying aetiology (e.g. infection, pain, stress, hypoxia, medications)
- Calculate glucose delivery rate (see chart), up to 12.5 mg/kg/min is acceptable if on PN
- Monitor urine glucose and urine volume (ml/kg/hr)

Glucose delivery rate >12.5 mg/kg/min (PN)
Glucose delivery rate > 10mg/kg/min (IV)

No

Blood glucose > 12mmol/L
And Glycosuria ≥ (3+)

D/W consultant
Start insulin
See insulin policy*

D/W with consultant
Expectant management

Yes

No

D/W with consultant
Expectant management

Blood glucose > 12mmol/L
And Glycosuria ≥ (3+)

Yes

No

Blood glucose > 12mmol/L
And Glycosuria ≥ (3+)

D/W consultant
Start insulin
See insulin policy*

D/W with consultant
Expectant management

Maintain glucose
Delivery rate between
10 - 12.5 mg/kg/min

* Prime the extension tubing (and the T piece) with insulin solution, wait for 30 minutes and purge 1-2ml (using syringe driver to get rid of the slack) before connecting to the infant to maintain insulin concentrations within 90% of the initial concentration.
Hyperglycaemia has been estimated to occur in between 45% and 80% of infants who survive the first week of life and is seen most frequently in very low birth weight infants. The mechanisms underlying neonatal hyperglycaemia vary and may be the result of a high glucose infusion rates (normal 4-6mg/kg/min), low glucose uptake rate, defective gluco-regulatory hormone control, underlying clinical stresses such as infection, respiratory distress, hypoxia, pain, surgery and use of steroids. Caffeine, diazoxide and phenytoin are also known to cause hyperglycaemia.

Active management strategies include carbohydrate restriction or intravenous insulin infusion or both. Potential hazards of insulin infusion are hypoglycaemia and hypokalaemia. Potential hazards of carbohydrate restriction include a reduction in total energy intake to a level, which may lead to a catabolic state during a critical illness at a critical stage of development. It is not clear which of these strategies is the safest or most effective in the short-term control of hyperglycaemia or in optimising nutrition. However the first step in management should be detailed evaluation and treatment of the underlying cause.

Treatment strategy

- Confirm the diagnosis by repeating the blood glucose.
- Monitor urine for glycosuria and urine volume (ml/kg/hr) to ensure adequate fluid balance. The urinary bladder should be catheterised if the baby is sick.
- If baby’s glucose delivery rate is already 4-6mg/kg/min and needs additional fluids to counter renal and extra-renal losses (phototherapy) consider using 5% dextrose.
- Hyperglycaemia in a previously normoglycaemic infant may be due to causes such as pain, stress, infection, hypoxia etc. Seek and treat serious underlying disorders especially infection (septic screen and antibiotics). Achieve adequate sedation and pain relief.
- Calculate glucose delivery rate (see chart). Glucose infusion rate (mg/kg/min) = concentration of dextrose (%) x flow-rate (ml/kg/day) ÷ 144. Remember to include all infusions with dextrose.
- If glucose delivery rate is >10mg/kg/min (IV) or >12.5 mg/kg/min (PN), decrease glucose intake (by 2 mg/kg/min every 4-6 hours) to 10 mg/kg/min either by reducing the concentration or rate or both.
• Monitor the falling blood glucose level. If on PN, glucose delivery rate up to 12.5 mg/kg/min is acceptable.

• If glycosuria (≥3+) and hyperglycaemia (≥12 mmol/L) persists despite an appropriate glucose infusion rate, discuss with consultant regarding the need of continuous insulin infusion.

• Insulin infusion (refer to insulin policy for infusion guidance) should be commenced via separate venous access (peripheral or central)

• Prime the extension tubing (T piece in place) with insulin solution and wait for 30 minutes before connecting to the infant to maintain insulin concentrations within 90% of the initial concentration. Refer to insulin policy for infusion guidance.

• The glucose delivery rate should be maintained at 10-12.5 mg/kg/min during insulin infusion to promote caloric intake, weight gain and prevent hypoglycaemia.

• Monitor blood glucose hourly in the first 4 hours and 2 hourly dependent on blood glucose stability until euglycaemia (5-7 mmol/L) is achieved.

References


### Guideline Development

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 2005</td>
<td>New Guideline</td>
</tr>
<tr>
<td>Jan 2009</td>
<td>Guideline Review</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>Review by author (VK) - no significant change to evidence</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>Neonatal Governance Meeting</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>Reviewed by audit group – no significant changes required</td>
</tr>
<tr>
<td>Jan 2019</td>
<td>Guideline reviewed by authors V R K / LS and guidelines lead REM - Minor changes only</td>
</tr>
<tr>
<td>Jan 2019</td>
<td>Neonatal Governance Meeting</td>
</tr>
</tbody>
</table>
Appendix 1
Glucose Rate calculator:
Interconversion of glucose infusion units

GLUCOSE RATE CALCULATOR
Use a straight edge to determine the volume required per 24 hours

(modified after Klaus MH, Fanaroff AA. Care of the High Risk Neonate 2nd Edition 1979)