RPA Newborn Care Guidelines
Royal Prince Alfred Hospital

Neonatal Hypoglycaemia

Definition:
Glucose is an essential nutrient for the brain. Abnormally low levels can cause an encephalopathy and have the potential to produce long term neurological injury.\(^1,2\) The level at which this potential for long term injury is reached is controversial. Traditional definitions were set by the studies of Cornblath et al\(^3\) as <1.1 mmol/l in growth restricted and preterm babies and <1.7 mmol/l in term babies. Srinivasan et al\(^4\) reported that there is a normal postnatal fall in BGL in healthy term infants – the lower range of the 95% confidence intervals of this nadir at 1-2 hours was a BGL 1.4 mmol. By 24 hours, the 95% CI were 2.4 mmol/L. Several recent studies have fuelled controversy about these definitions. Koh et al\(^5\) showed reversible disturbance in evoked potentials at glucose levels below 2.6 mmol/l in asymptomatic term babies. It is important to emphasise that this outcome does not equate to permanent neurological injury. And in preterm babies, Lucas et al\(^6\) found glucose levels below 2.5 mmol/l were associated with worse neurodevelopmental outcome. Duvanel et al\(^7\) reported that growth restricted infants with recurrent moderate hypoglycaemia (5 episodes with plasma glucose levels >0.6 and <2.6 mmol/L) or 1 single severe hypoglycaemic episode (0 to 0.6 mmol/L) had lower psychomotor development scores at 3.5 and 5 years age. Preterm babies have an impaired ability to produce a ketone (an alternative brain fuel) response to low glucose levels.\(^8\) In light of this lack of firm evidence, we have evolved these arbitrary definitions.

SBGL = screening blood glucose level (glucometer).
FBGL = formal blood glucose level (IStat or laboratory).

1. Postnatal Ward management
In at risk asymptomatic term or near term babies (>34 weeks).
• Blood glucose levels above 2 mmol/l are acceptable on day 1.
• Blood glucose levels between 1.5 and 2 mmol/l should be acted on as detailed below and not tolerated for long (the effect of one feed).
• After 24 hours the normal range of BGL is >2.5 mmol/L

2. Special Care Nursery / NICU management
High risk but otherwise well infants of type 1 or unstable diabetic mothers
• Blood glucose levels should be maintained above 2 mmol/L in 1st 24 hours
• After 24 hours the normal range of BGL is >2.5 mmol/L.

In preterm babies (<35 weeks) OR sick term babies.
• Blood glucose levels should be maintained above 2.5 mmol/l.
• After 24 hours the normal range of BGL is >2.5 mmol/L. In SGA infants (birthweight <10th percentile) the FBGL should be maintained ≥2.5 mmol/L after 24 hours.

Incidence:
In 1997, 28 babies (3%) were admitted to RPA Newborn Care with hypoglycaemia as the primary diagnosis. The true incidence will vary depending on the definition applied by an individual unit.

Diagnosis:
Most infants with a low BGL will be asymptomatic. Signs of hypoglycaemia may include:
• Poor feeding – infants who are not demand feeding OR have < 3 feeds in 1st 24 hours OR < 6 feeds in the following 24 hours should have a SBGL to ensure the poor feeding is not secondary to hypoglycaemia. These infants should be referred to the lactation team and / or senior midwife to evaluate feeding if the SBGL is within normal range.
• Jitteriness and irritability
• Apnoea and cyanosis
• Hypotonia
• Convulsions

Screening for hypoglycaemia is performed with a blood reagent strip. These are inaccurate at the lower end of the range tending to under read the true blood glucose. Except for very low SBGLs (<1.0 mmol/L), it is imperative that before treatment is commenced a FBGL is performed to validate low SBGL.\textsuperscript{9,10}

Prevention of hypoglycaemia is the therapeutic goal. When babies are admitted to the NICU for other reasons such as prematurity, the routine is glucose screening and there should be a low threshold for instituting IV therapy. It is the babies who would not otherwise be admitted to NICU who present the challenge in terms of prevention. In addition to arbitrary definitions cited above, three important points govern the following prevention protocol.

1. There is a normal dip in blood glucose in the first 2 to 4 hours postnatally.
2. Accu-Check strips using the Accu-Check\textsuperscript{\textregistered} Advantage Meter under read blood glucose in the low range. The Advantage glucometer may be inaccurate at lower blood glucose levels, with a mean difference of 1.07mmol/l compared to a FBGL at low glucose ranges.\textsuperscript{9,10}
3. Active intervention should only be undertaken for a very low SBSL (<1.0 mmol/L) OR after confirmation of a higher SBGL (>1.0 to <2.0mmol/L) with a formal blood glucose level (FBGL).

**Formal BGL** – performed for confirmation of hypoglycaemia

1. **Postnatal wards**: place blood sample in a lithium heparin tube and transport immediately to biochemistry. Phone the laboratory (58279 / 58442) to ensure immediate analysis of specimen. Undue delay will result in falsely low BGL and inappropriate management.

2. **RPA Newborn Care**: Use the i-Stat glucose cartridge located in NICU.

### Prevention of hypoglycaemia on delivery suite and postnatal wards

The following groups of babies are at risk of hypoglycaemia and need attention paid to early establishment of breast feeding and screening blood glucose level (SBGL) with a cotside screening device such as the Accu-Check\textsuperscript{\textregistered} Advantage Meter currently in use at RPA.

#### Classification of infant risk:
Infants are classified as increased risk and high risk depending on their likelihood of severe neonatal hypoglycaemia.

<table>
<thead>
<tr>
<th>Antenatal</th>
<th>Increased risk Admit to Postnatal</th>
<th>High risk Admit to SCN / NICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother preexisting type 1 diabetes</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mother preexisting type 2 diabetes:</td>
<td></td>
<td>X</td>
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<tr>
<td>• most recent HbA1C &gt;6g%</td>
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<tr>
<td>• Poor recent control (daily BGL &gt;8 mmol/L)\textsuperscript{11}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother preexisting type 2 diabetes not on insulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• most recent HbA1C ≤6g%</td>
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<td></td>
</tr>
<tr>
<td>• Good recent control</td>
<td>X</td>
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<tr>
<td>Mother gestational diabetes</td>
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</tbody>
</table>

| Postpartum | |
| Preterm 35 or 36 weeks | X |
| Preterm <35 weeks | X |
Low birth weight <2200g | X
Infant macrosomic | X
Infant has signs of hypoglycaemia | X
Infant appears ‘wasted’ | X
Infant SGA (<10th percentile) - See table | X

**Definitions (WHO [http://www.who.int/topics/diabetes_mellitus/en/](http://www.who.int/topics/diabetes_mellitus/en/)):**
- Type 1 diabetes: (previously known as insulin-dependent or childhood-onset diabetes) is characterized by a lack of insulin production. Insulin is required for survival.
- Type 2 diabetes: (formerly called non-insulin-dependent or adult-onset diabetes) is caused by the body’s ineffective use of insulin. It often results from excess body weight and physical inactivity. Insulin may be required for control.
- Gestational diabetes: is hyperglycemia that is first recognized during pregnancy. Insulin may be required for control – occasionally for survival.

**Infants at increased risk:**
*These infants may be transferred to the postnatal wards if otherwise well and undergo monitoring as per the increased risk policy.*

1. Infants of mothers with:
   a. Gestational diabetes AND HbA1c ≤6g% AND good recent control (BGL <8 mmol/L).
   b. Type II diabetes AND HbA1c ≤6g% AND good recent control (BGL <8 mmol/L):
2. Preterm babies (35-36 weeks inclusive) as per admission policy.
3. "Wasted babies": infants with birth weight in the normal range but a low weight relative to length. These are a difficult group of babies to identify and, when examining babies immediately after birth, a high level of suspicion is needed. On examination these babies usually have loose skin folds on upper arms, thighs and over the abdominal and scapular regions. The umbilical cord appears thin and loss of Wharton's Jelly may be evident.

4. Small for gestational age or low birth weight infants: infants with birthweight <10th percentile or <2500g (low birthweight) are at increased risk of hypoglycaemia (see table)

<table>
<thead>
<tr>
<th>37 weeks</th>
<th>&lt;2500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 weeks</td>
<td>&lt;2500g</td>
</tr>
<tr>
<td>39 weeks</td>
<td>&lt;2600g</td>
</tr>
<tr>
<td>40+ weeks</td>
<td>&lt;2800g</td>
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</tbody>
</table>

**High risk infants:**
*Infants at high risk are to be admitted to the nursery and have a SBGL by 1 hour of age.*

These include:
1. Infants of mothers with:
   a. Type 1 diabetes
   b. Type 2 diabetes and
   - Most recent HbA1c >6g% or
• poor recent control (daily BGL >8 mmol/L)

3. Macrosomic baby: ie physical appearance of an infant of a diabetic mother in the absence of a history of maternal diabetes. These babies have increased subcutaneous fat, are plethoric and have a small head in relation to their body size. These babies need an early neonatal medical review and SBGL within 2 hours of birth.

4. Babies with symptoms which may be due to hypoglycaemia: If the SBGL is low (<2mmol/L) in a symptomatic baby then confirm with a formal blood glucose (FBGL). Urgent intravenous glucose is indicated. Subsequent SBGLs are not indicated in "jittery" babies who have a SBGL > 2.5mmol/L and are feeding well.

Timing of blood glucose screening in at risk babies?

Postnatal Ward
During first 24 hours
It is essential that all ‘increased risk’ infants have their first feed in delivery suite or the Birth Centre or recovery as soon as possible after birth and same documented on the Newborn Care Chart (MR504). The second feed should occur within 6 hours of birth and the first SBGL performed 30 minutes after this feed. Note: there is a normal postnatal fall in blood glucose which lasts 2 to 3 hours.

If subsequent SBGLs are >2.5 mmol/L for 3 consecutive readings & the baby appears well and is feeding well, cease SBGL

If the second SBGL is 2-2.5 mmol/L continue SBSL monitoring for additional 24 hours (see below for persistent SBGL <2.5.mmol/L).

After 24 hours age:
Normal SBGL for well term babies and well preterm babies ≥35 week should be >2.5 mmol/L

If SBGL persist <2.5 mmol/L beyond 24 hours the infant should be reviewed by a senior Neonatal doctor (either consultant or fellow).

Special Care nursery / NICU

All high risk babies: if baby is considered at ‘high risk’ for hypoglycaemia admit to the nursery and have SBGL by 1 hour of age.

SBGL is performed 30 min after feed:
• Normal SBGL for well term babies and well preterm babies ≥35 week >2 mmol/L
• Normal SBSL for sick term babies and preterm babies <35 week >2.5 mmol/L

Formal BGL – performed after SBGL for confirmation of hypoglycaemia using:
1. Postnatal wards: place blood sample in a lithium heparin tube and transport immediately to biochemistry. Phone the laboratory (58279 / 58442) to ensure immediate analysis of specimen. Undue delay will result in falsely low BGL and inappropriate management.

2. RPA Newborn Care: the I-Stat glucose cartridge located in NICU.

Subsequent action should be directed by the following chart.
Postnatal Ward Management Flow Chart
Procedure for term infants increased risk of hypoglycaemia: Postnatal Ward

First SBGL >2 mmol/L (Normal)
- Check SBGL for 12 hours
  - Aim for a minimum 5 feeds in 1st 24 hours.
  - If all SBGLs are >2.5 mmol/L for 3 consecutive readings & infant is feeding well, cease SBGL after 12 hours
- If first or subsequent SBGL falls < 2.5mmol/L continue SBLs for another 24 hours.
  - Beyond 24 hours paediatric review needed if SBGLs remain < 2.5mmol/l

First SBGL 1.5-2 mmol/L
- Complimentary feed ASAP & repeat SBGL 30 min after feed
  - If SBGL is still ≤2 mmol/L
    - Contact neonatal RMO
    - Do formal BGL (FBGL)

First SBGL ≤1.4 mmol/L
- Contact neonatal RMO urgently
  - If FBGL ≤2 mmol/L
    - Admit to SCN
    - See high risk flow chart

Admit to SCN
- See high risk flow chart
Procedure for term infants at high risk of Hypoglycaemia: Special Care Nursery

Infants at high risk are to be admitted to the nursery and have a SBGL by 1 hour of age.

First SBGL >2 mmol/L  
Continue to establish early regular breast feeding. Minimum of 5 feeds in 1st 24 hours

If SBGL >2.0 mmol/L & feeding well, Check SBGL for 12 hours in SCN

Transfer to Postnatal ward

First SBGL 1-2 mmol/L  
Complimentary feed ASAP FBGL 30 min after feed

Contact neonatal RMO urgently

FBGL ≤ 2 mmol/L

Rapid stepwise approach to low BGL:

FBGL 1.5-2 mmol/L
- Continue breast feeding
- Complimentary feed (bottle or tube feeds)
- Commence IV 10% dextrose at 60-90 ml/kg/day if FBGL not maintaining above 2.0 mmol/L

FBGL 1-1.5 mmol/L
- Continue IV 10% dextrose at 60-90 ml/kg/day to maintain normal blood glucose

FBGL <1.0 mmol/L
- IV bolus of 10% dextrose at 2.5 ml/kg
- Ensure BGL has increased to >1.5 mmol/L
- Continue IV 10% dextrose at 60-90 ml/kg/day to maintain normal blood glucose

First SBGL <1.0 mmol/L  
Contact neonatal RMO
- Tube feed if there is a delay in IV treatment
- Immediate IV treatment
- Send FBGL

Contact neonatal RMO urgently

FBGL ≤ 2 mmol/L
REFERENCES