Guideline for the Prevention and Management of Neonatal Hypoglycaemia
GL359

Approval and Authorisation

<table>
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<tr>
<th>Approved by</th>
<th>Job Title</th>
<th>Date</th>
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<tr>
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Author: A F Gordon
Job Title: Consultant Paediatrician
Policy Lead: Urgent Care Group Director
Location: Corporate Governance Shared Drive – GL359
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Guideline for the Prevention, Detection and Management of Hypoglycaemia of the New Born

Purpose
The purpose of this guideline is to ensure that those at risk of potentially significant hypoglycaemia are detected and managed appropriately without interfering unnecessarily with the care of normal babies.

Function
This guideline provides guidance on the prevention, detection and management of neonatal hypoglycaemia. It is for use on the delivery suite, postnatal wards and neonatal unit of the Royal Berkshire Hospital. It is for use by all health professionals involved in looking after the new born infant. All babies in whom glucose monitoring has been carried out should have a care plan documented in the notes.

Introduction
Healthy term infants often feed infrequently in the first 24 hours. Hypoglycaemia is one of the most common metabolic problems in the neonatal period. In the majority of infants low blood glucose concentrations are not related to any significant problem and merely reflect normal processes of adaptation to extrauterine life which occur in the first 48 hours of life. Prolonged or severe or recurrent hypoglycaemia may result in acute systemic effects and neurological sequelae. The level and duration of hypoglycaemia associated with long term damage is uncertain and controversial. Once this period of adaptation is over a blood sugar of >2.5mmol/l is generally regarded as normal.

Causes of Hypoglycaemia
1. Septicaemia
2. Intrauterine growth retardation (IUGR)
3. Maternal diabetes
4. Maternal drugs eg beta blockers
5. Severe Rhesus disease
6. Fits
7. Inborn errors of metabolism
8. Beckwith-Weidemann Syndrome
9. Primary Islet Cell disorders
10. Pituitary insufficiency

Clinical Signs/Symptoms of hypoglycaemia
1. Cerebral irritability eg fits, irritability, marked jitteriness
2. Coma, lethargy
3. Hypotonia
4. Apnoea

Infants at Risk Requiring Regular Blood glucose measurements
1. Small for dates infants (<2nd centile or < 2.5kg at term)
2. Clinically wasted infants regardless of weight.
3. Infants of diabetic mothers
4. Macrosomic infants
5. Post mature infants if clinically wasted
6. Moderate to severe birth asphyxia (5 minute apgar score < 8)
7. Preterm infants particularly those with RDS
8. Severe Rhesus disease
9. Septicaemia
10. hypothermia.

Delivery Suite and Postnatal Ward Management

Prevention of hypoglycaemia.

All babies should be kept warm and encouraged to have skin to skin contact with their mothers after birth.

All babies should be encouraged to feed as soon as possible after birth. Babies whose mothers wish to breast feed should be helped to do this as soon as possible after birth. Ongoing support in breast feeding should be offered to all women who wish to do so. Encourage mothers who wish to breast feed to express milk if the baby is not able to suck.

Normal term babies do not require blood glucose screening unless they are showing clinical signs of being unwell.

Feeding Problems

Healthy, appropriately grown, term breast fed infants with latching problems:

Give mother full breast feeding support and help.

Encourage skin to skin contact and unlimited access to the breast

Examine the infant carefully to check no signs of illness.

If there are signs of insufficient milk intake eg excessive weight loss, lethargy consider other pathology and measure the blood glucose. and give EBM or formula by bottle, cup or tube and continue to offer the breast at each feed. If the baby appears unwell contact the paediatrician even if the sugar is normal.

Small infants who are not feeding well by breast or bottle

Encourage mother to express breastmilk 8 times in 24 hours including once at night.

Encourage skin-skin contact and unlimited access to breast if breast feeding.

Examine the infant carefully to check no signs of illness.

Any abnormal clinical signs manage as below

**Babies in at risk groups** should be encouraged to feed immediately after birth and 3-4 hourly after that depending on the blood sugars.

“**At Risk” Infants who need Blood glucose Screening and Special management**
The following infants must have regular pre-feed blood glucose monitoring, close observation of clinical and neurological status, and support of feeding. **All the above must be clearly documented in the notes.**

If the mother intends to bottle feed start at 90-100ml/kg/day by bottle or tube. If mother wishes to breast feed and baby can suck well be guided by clinical condition and blood sugars. Offer the breast before formula. If the baby is unable to suck then will need tube feed with EBM/formula starting at 90-100ml/kg.

1. Infants <2500g
2. Infants <36 weeks gestation
3. Clinically wasted infants
4. Infants of diabetic mothers (both gestational and insulin dependant)
5. Infants of macrosomic appearance
6. Infants who are cold(temperature, 36c)
7. Infants who become unduly sleepy.

**Frequency of monitoring**

A blood sugar should be checked prior to the second feed and within 4 hours of birth.

Unless the baby shows symptoms of hypoglycaemia it is best **not** to do it in the first 1-2 hours after birth.

Blood sugars should be checked at least 3 times in the first 12 hours after birth.

Blood sugars should be checked at least twice in the second 12 hours after birth.

Monitoring may stop when the blood glucose has been >2.5mmol on 2 occasions in the 2nd 24 hours of life and the baby is feeding well.

(Glucostix may be used for monitoring blood sugar, but if BG <2.0mmol. recheck using Buscot machine).

**Management**

1. **If Gluco stix/blood glucose <1mmol/l**

**CALL PAEDIATRIC SHO URGENTLY DAY OR NIGHT** who will take sample to confirm blood glucose and admit the baby to the neonatal unit for further investigation and management. Feed the baby if there is any delay in their arrival.

2. **If there are abnormal signs/symptoms, at any blood glucose level**

**CALL PAEDIATRIC SHO URGENTLY DAY OR NIGHT** who will assess the baby and consider admission of the baby to the neonatal unit for investigation and treatment. If the SHO is unavailable call the registrar.
3. **If no abnormal signs and blood glucose >2.0mmol/l**

Feed normally and continue clinical and blood glucose monitoring as before. Should stabilise at >2.5 mmol/l by 48-72 hours.
If this has not happened contact paediatrician.

4. **If no abnormal signs and first blood glucose 1.0-2.0mmol/l**

Increase feed frequency and/or volume as tolerated and give EBM or formula supplements after offering the baby the breast (if breast feeding). Check blood glucose before next feed and within 4 hours. If baby unable to suck give tube/cup feed.

**If repeat blood glucose 1.0-2.0mmol/l despite increasing feeds**

Admit to special care nursery for frequent tube feeds or IV glucose.

5. **If blood glucose >2.5mmol/l on 2 consecutive occasions by the 2nd 24 hours of life.**

Discontinue monitoring but recommence if feed intake falls, there is clinical concern, or signs of hypoglycaemia.

**Management of babies who require admission to NNU**

**Prevention of hypoglycaemia**

1. Ensure that the baby is kept warm
2. For infants at risk, start IV fluids or enteral feeds as soon as possible after birth.
3. Sick infants will require a 10% dextrose infusion and this should prevent hypoglycaemia in the majority but they must still be screened and the glucose intake adjusted if they are hypoglycaemic.
4. Infants who do not require IV fluids should be started on oral feeds as soon as possible after birth. If the mother wishes to breast feed and the baby is well, the baby should go to the breast immediately after delivery and skin to skin contact encouraged. The mother should be encouraged to express milk from day 0 if feeding problems are anticipated. EBM or formula supplements should be given as indicated by the infant’s clinical state and blood glucose measurements. If early breast feeding is impossible or the mother wishes to formula feed, then a formula feed of approximately 10ml/kg should be given initially. The frequency and volume of feeds will be dictated by clinical state.

**Tube fed infants**

1. Give EBM or formula
2. AGA infants start at 60ml/kg
3. SGA/wasted/Infants of diabetic mothers start at 90ml/kg
4. Feed hourly initially and increase feed interval if glucose >2.5mmol and infant tolerates the feed.

Intravenous fluids

1. Usual starting volume 60ml/kg/24hours or 90ml/kg/day if IUGR of 10% dextrose.
2. If sugars remain low increase the volume or concentration if the baby is fluid restricted.
3. 10% and 12.5% dextrose may be given via peripheral vein. Stronger concentrations should be administered via a central line or umbilical catheter. The position of these lines must be checked.

Frequency of blood glucose monitoring

1. Blood glucose monitoring is only one aspect of clinical monitoring and does not replace good clinical observation. **Clinical assessment should be documented with blood glucose check especially if it is low.**
2. Glucostix may be used to monitor blood glucose. **Any level < 1mmol/l or result which leads to a management change must be confirmed with a blood gas machine sugar and true laboratory glucose.**
3. Check blood glucose within first 4 hours of birth but remember it is almost always low in 1st 1-2 hours and the trend is very important.
4. Repeat at least 4 hourly until 2 consecutive readings are > 2.5mmol/l, then daily until baby is stable.
5. Recheck if feed interval is changed or feed intake reduces or baby is unwell.
6. In very sick babies eg severe Rhesus/HIE/sepsis or symptomatic babies measure glucose hourly until stable.

When to intervene

Term Infants

Blood glucose should only be checked in term babies who have clinical signs or are in an at risk group. Normal babies do not require blood glucose screening.
If a normal term infant has clinical signs and a low sugar then it is likely that there is an underlying problem and this must be investigated.

Infant with abnormal Clinical Signs

Measure the blood glucose. If the value is <2.5mmol, interventions aimed at increasing the blood glucose are indicated. Remember HYPOGLYCAEMIA IS LIKELY TO BE THE RESULT OF AN UNDERLYING PATHOLOGICAL PROCESS eg INFECTION AND THIS MUST BE INVESTIGATED. Aim to keep the blood glucose >2.5mmol/l

Infants with Risk Factors for Hypoglycaemia but no abnormal clinical signs

If blood glucose is 1-2mmol/l, monitor closely and measure blood glucose again within 4 hours. **Assess clinical and neurological status and clearly document this.**
Intervention must occur if plasma glucose remains at or below this level, does not increase after a feed, or abnormal signs develop.

**If blood glucose <1mmol, immediate intervention aimed at raising the blood glucose to > 2.5mmol/l is required.**

**Very Low Birthweight and “Sick” infants eg infection/HIE/premature**

Prescribe fluid to maintain glucose at > 2.5-3.0mmol/l.

**Intervention**

The intervention used to ensure that blood glucose concentrations do not remain low will depend on the blood glucose level and trend in time, the baby’s clinical condition, the mothers chosen method of feeding and any co-existant pathology. Possible interventions include optimal breast feeding support, supplementation of feeds with expressed milk or formula or intravenous glucose.

**Examples**

Major clinical signs eg fits/coma – urgent IV glucose  
Blood glucose <1mmol urgent IV glucose  
Baby feeding poorly and blood glucose 1-2mmol/l but neurologically normal – give tube feed of formula or EBM and continue clinical observation and frequent blood glucose monitoring.  
Baby on IV fluids and blood glucose persistently <2.5mmol/l increase fluid volume or glucose concentration.
Intravenous Glucose Administration

10% and 12.5% dextrose may be given via peripheral vein. Stronger concentrations should be administered via a central line or umbilical catheter. The position of these lines must be checked on x-ray.

Normal glucose requirements are 5-6mg/kg/min = 90ml/kg of 10% dextrose. Requirements of over 8-10mg/kg/min are suggestive of hyperinsulism.

Rate of Glucose Administration

<table>
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<th>IV rate ml/kg/d</th>
<th>Glucose Concentration</th>
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<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>60</td>
<td>4.2mg/kg/min</td>
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<tr>
<td>90</td>
<td>6.25mg/kg/min</td>
</tr>
<tr>
<td>120</td>
<td>8.3mg/kg/min</td>
</tr>
<tr>
<td>150</td>
<td>10.4mg/kg/min</td>
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Remember

Do not stop the glucose infusion suddenly as rebound hypoglycaemia may occur. Make changes gradually.

Special cases

Infants with severe neurological symptoms eg fits/coma

This is an emergency. Establish vascular access. Take sample to confirm blood glucose and diagnostic samples. (see appendixA) Give 3ml/kg of 10% dextrose and start a glucose infusion.

Babies who need Further Investigation (Hypoglycaemia screen see appendix A)

1. All babies with symptomatic hypoglycaemia.
2. Babies with persistent hypoglycaemia beyond 72 hours of life.
3. Babies with high glucose requirements (>8mg/kg/min) after the first 48 hours of life.

Investigations

These should be taken when the baby is hypoglycaemic. Remember to collect the urine. See appendix 1 for investigations and sample bottles. The hypoglycaemia screen takes quite a lot of blood so check a blood gas machine glucose before taking the full screen.

Discharge of babies who have had a “hypoglycaemia screen"
The results of the cortisol level must be back prior to discharge. For babies who are going home before all results are known (ie we do not have a diagnosis) a 6 hour fast should be carried out prior to discharge. The blood sugar should be >2.5mmol. Ask the mother to feed the baby 4 hourly until the first clinic visit when all results should be available. Please ensure that results are chased up and put into the notes. Abnormal results should be acted on immediately. Document that you have discussed the above with the parents.

**Treatments for severe refractory hypoglycaemia**

1. Glucagon (see BNF for Children for dosage)
2. Hydrocortisone (see BNF for children for dosage)
3. Diazoxide (see BNF for children for dosage) useful in hyperinsulism.

**Hypostop** (glucose gel polymer) may be used as emergency management until IV access is established.

**DO NOT START THE ABOVE WITHOUT DISCUSSION WITH A CONSULTANT**

**SUMMARY OF MANAGEMENT FOR BABIES ON NNU OR POSTNATAL WARDS**

<table>
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<th>Status</th>
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<tr>
<td>Sick or preterm on NNU</td>
<td>Aim for glucose &gt; 2.5mmol/l</td>
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<tr>
<td>Baby with clinical signs</td>
<td>Investigate, IV glucose, aim for glucose &gt;2.5mmol</td>
</tr>
<tr>
<td>At risk infants – feeding well, no abnormal signs, glucose &gt;2.0mmol/l</td>
<td>Observe and monitor no formula supplements</td>
</tr>
<tr>
<td>At risk infants – glucose 1-2mmol/l on 2 consecutive occasions no abnormal signs.</td>
<td>Continue breast feeding or bottle feeding, <strong>plus</strong> EBM or Formula supplements by tube /bottle with more frequent feeds if needed. (may need admitted to NNU)</td>
</tr>
<tr>
<td>At risk infant – glucose &lt;1mmol/l or neurological signs.</td>
<td>Admit to NNU for IV glucose and investigation.</td>
</tr>
<tr>
<td>Healthy,term AGA baby</td>
<td>No Glucose monitoring</td>
</tr>
</tbody>
</table>
References

3. NICE clinical Guideline 63 Diabetes in Pregnancy.
Appendix 1
SPECIMEN REQUIREMENTS FOR THE INVESTIGATION OF NEONATAL HYPOGLYCAEMIA

Samples for glucose, insulin, free fatty acids & β hydroxy butyrate MUST be taken during the hypoglycaemic episode. Urine should also be taken when the patient is symptomatic. Glucose levels MUST be confirmed in the laboratory as occasionally glucose meters can give spuriously low readings.

Please note all volumes stated are the minimum required to perform the analysis once.

BLOOD

Amino Acids: Minimum 2 full blood spots on neonatal screening card
Cortisol: 0.8 ml in plain tube (red)
Free fatty acids & β hydroxy butyrate: 1.2ml lithium heparin (green) on ice to lab immediately
Glucose: 0.4 ml lithium heparin.
Growth hormone: 1.4 ml SST (yellow) or plain tube (red).
Insulin: 1.2 ml lithium heparin on ice to lab immediately. Contact ext 7704 or bleep on call staff before sending blood

MCAD screen: Minimum 2 full blood spots on Guthrie card.

If a glycogen storage disorder is suspected lactate measurement will also be useful.

Lactate: 0.5ml lithium heparin on ice to lab immediately. Contact ext 7704 or bleep on call staff before sending blood.

URINE

Samples should be collected into a plain container without preservative.

Amino acids: random collection, no preservative, send to lab same day
Organic acids,
Reducing substances,
Ketones: random collection, ideally 5ml to be sent to laboratory within 3hr of collection

The absolute minimum sample requirements for glucose, insulin, FFA & β hydroxy butyrate, ketones, reducing substances, organic acids, amino acids, MCAD screen are:

4 blood spots on a Guthrie card
urine - minimum 3ml
4 fully filled paediatric lithium heparin bottles (green top)

This may NOT be sufficient for all the tests if the neonate has a high PCV. Also if there are any analytical problems with the assays there will not be enough to repeat the tests. Samples for cortisol and growth hormone can be taken at a later time. The minimum requirements for these are 3 fully filled paediatric SST (yellow or red top).

(Agreed by the Biochemistry department of the Royal Berkshire NHS Foundation Trust)

At Birth:
- Dry baby. Keep warm. Initiate skin to skin contact.
- Support first feed as soon as possible, always within first hour.
- Observe well-being.
- Feed effectively?
- Document care-plan

Proactive management:
- Observe baby
- Teach to hand express, give EBM (if unavailable, express hourly)
- Continue skin to skin contact/keep baby warm

Action:
Within 4hrs of birth – before 2nd feed
- Pre-feed Review
  (report abnormal signs to paediatrician)
- Pre-feed BG measurement
- Breastfeed and/or give EBM

Was pre-feed BG >2mmoll?
- NO
- YES

Action: (recheck BG on Buscoat machine)
- Offer the breast more frequently, and give EBM supplements (if unavailable, give formula, 90ml/kg/day)
- Keep warm
- Repeat BG within 3hrs – if remains <2mmoll, treat as symptomatic hypoglycaemia**

Ongoing management for first 24 hours:
- Pre-feed Review
  (report abnormal signs to paediatrician)
- At least 3hrly breastfeeding/EBM (ensure mum knows how to hand express).
- Pre-feed blood glucose (BG), 3 times in first 12 hours, (initially prior to 2nd feed and not in first 2 hours of birth unless unwell).
- Encourage mother to observe feeding cues.
- Give further skin contact and keep baby warm.
- Full breastfeeding assessment at 2nd feed or within 6hrs.
- BG - 2 times in 12-24 hours.

Ongoing management from 24 hours:
- Pre-feed Review
  (report abnormal signs to paediatrician)
- At least 3hrly breastfeeding/EBM.
- Continue skin contact and ensuring baby is warm.
- Monitoring may stop when BG has been >2.5mmoll on two occasions in 24 hours, and baby is feeding well.
- BG should stabilise by 48-72 hours, if not inform paediatrician. **

At risk newborns:
- Preterm, <36 weeks
- Infants, <2500kg
- Clinically wasted
- Maternal Diabetes
- Infants of macroscopic appearance
- Cold infants, <36C
- Infants who are unduly sleepy (is this child sick?)
- Maternal use of B blockers

Pre-feed Review*:
(Report abnormal signs to paediatrician)
- Level of consciousness
- Tone
- Temperature
- Respiration
- Colour

Symptomatic hypoglycaemia:
If a newborn shows signs of:
Anoect, Syncope, Sickness, Convulsions, altered level of consciousness, Blood glucose <2.0 mmoll at any stage, refer to paediatrician urgently.

Adapted from Baby Friendly Guidelines on Hypoglycaemia of the newborn.

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Author: A F Gordon
Job Title: Consultant Paediatrician
Policy Lead: Urgent Care Group Director
Location: Corporate Governance Shared Drive – GL359
Date: March 2016
Review Date: March 2018
Version: 2.9

At Birth:
- Dry baby. Keep warm. Initiate skin to skin contact.
- Support first feed as soon as possible, always within first hour.
- Observe well-being.
- Fed effectively?
- Document care plan.

Proactive management:
- Observe baby
- Continue skin to skin contact/keep baby warm

Ongoing management for first 24 hours:
- Pre-feed Review*
  (report abnormal signs to paediatrician)
- Pre-feed BG measurement
- Bottlefeed. Offer 80-100ml/kg/day.

Action: Within 4hrs of birth – before 2nd feed
- Pre-feed Review*
  (report abnormal signs to paediatrician)
- Pre-feed BG measurement
- Bottlefeed. Offer 80-100ml/kg/day.

Was pre-feed BG >2mmol/l?

Ongoing management from 24 hours:
- Pre-feed Review*
  (report abnormal signs to paediatrician)
- At least 3hrly feeds
- Encourage mother to observe feeding cues.
- Give further skin contact and keep baby warm.
- Pre-feed blood glucose (BG)
  3 times in first 12 hours, (initially prior to 2nd feed and not in first 2 hours of birth unless unwell).
  8G - 2 times in 12-24 hours.

Action: (recheck BG on glucometer machine)
- Increase frequency and/or volume of feeds
- Keep warm
- Repeat BG within 3hrs. If remains <2mmol/l treat as symptomatic hypoglycaemia**

At risk newborns:
- Preterm, <35 weeks
- Infants, <2.5kg
- Clinically wasted
- Maternal Diabetes
- Infants of macroscopic appearance
- Cold Infants, <36C
- Infants who are unduly sleepy
- Maternal use of E blockers

Pre-feed Review*
  (report abnormal signs to paediatrician)
  - Level of consciousness
  - Tone
  - Temperature
  - Respiration
  - Colour

**Symptomatic hypoglycaemia:
If a newborn shows signs of:
- Aprexia, Cyanosis, Jitteriness, Convulsions, altered level of consciousness, Blood glucose <2.0 mmol/l at any stage:
  refer to paediatrician urgently.

Adapted from Baby Friendly Guidelines on Hypoglycaemia of the newborn

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