

Neonatal hypoglycaemia: Management on Neonatal Unit**Key Points**

In summary, the approach to babies with persistent or recurrent low BG is:

- Early detection by ensuring relevant appropriate screening investigations are collected;
- Admission to NNU to ensure that management with adequate energy provision is provided;
- Keep Blood Glucose level > 3.0mmol/l for first 48 hrs (until insulin levels are known) and then >3.5 mmol/L if hyperinsulinemia confirmed;
- Higher Glucose infusion rate may be required and can be given as high as required via central line
- Seek early specialist advice about additional investigations and management like ECHO and Endocrine advice

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Abbreviations

AGA	Appropriate for gestational age
BG	Blood glucose
BSL	Blood sugar level
BW	Birth weight
CBG	Capillary blood gas glucose
EBM	Expressed breast milk
IUGR	Intra uterine growth restriction
IV	Intravenous
MCADD	Medium-chain acyl-CoA dehydrogenase deficiency
NNU	Neonatal unit
SGA	Small for gestational age
UVC	Umbilical venous catheter
WHO	World Health Organisation

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1. Normal neonatal metabolic adaptation

- Term, well grown, healthy infants are able to adapt to periods of low blood glucose levels. There is good evidence that ketone bodies are an alternative cerebral energy source in the neonatal brain whilst feeding is being established in the first 24 - 48 hours.
- Blood glucose measurements taken prior to 2 hours of age are not informative in well term babies and hence should not be done.
- Prolonged, severe hypoglycaemia is associated with neurological dysfunction and long term neurodevelopmental sequelae.
- There are some groups of newborns who are at greater risk of symptomatic hypoglycaemia and risk of neuronal damage.

For example, **preterm infants and IUGR/SGA infants** may have reduced glycogen stores, impaired gluconeogenesis due to liver immaturity and additional suppression of ketones production (as an alternative substrate).

2. Identification of infants at risk of impaired metabolic adaptation and recognition of clinical signs

2.1 The following groups are at risk of neurological sequelae of neonatal hypoglycaemia, and measures should be in place to identify them at birth for early milk / energy provision and monitoring of blood glucose concentration:

- Fetal growth restriction: as indicated by birth weight <2nd centile (small for gestational, Table 1) or clinically wasted (e.g. >2 centiles discrepancy between occipital frontal circumference (OFC) and weight using age and sex normalised charts).
- Infants of mothers taking beta-blockers such as propranolol, labetalol in the third trimester and / or at time of delivery
- Preterm (<37 weeks gestation)
- Maternal diabetes (all types including gestational diabetes)
- Hypothermia
- Infection clinically suspected or confirmed early onset neonatal infection (but not babies who have undergone infection screens for risk factors only)
- Hypoxic Ischemia Encephalopathy
- Large syndromic baby (birth weight 91st centile, Table 2)
- Polycythaemia
- Family history of MCADD or history of first degree relative with a heritable disorder associated with neonatal hypoglycaemia. eg pituitary / adrenal insufficiency or inborn errors of metabolism. Where possible, this should be planned before birth so that parents and staff are prepared.

Birth weight on 2 nd centile / kg according to WHO charts		
Gestational age / weeks	Boys	Girls
37	2.10	2.00
38	2.30	2.20
39	2.50	2.45
40	2.65	2.60
41	2.80	2.75
42	2.90	2.85

Table 1. Second centile birth weights for boys and girls by week of gestation (from BAPM Newborn Early Warning Trigger and Track Framework)

Birth weight on 91 st centile / kg		
Gestational age / weeks	Boys	Girls
37	3.450	3.400
38	3.700	3.600
39	3.950	3.800
40	4.150	4.000
41	4.350	4.150
42	4.500	4.250

Table 2. 91st centile birth weights for boys and girls by week of gestation. This is applicable to syndromic babies only.

* Moderate to late preterm infants are at risk of hypoglycaemia. Energy provision and blood glucose monitoring should be planned as part of the care pathway for preterm babies.

2.2 Measurement of blood glucose concentration should be performed for any infant who has one or more of the following diagnoses or clinical signs

- Perinatal acidosis (cord arterial or infant pH <7.1 and base deficit $\geq$ -12mmol/l)
 - Hypothermia (<36.5 °C) not attributed to environmental factors
 - Suspected / confirmed early onset sepsis
 - Cyanosis
 - Apnoea
 - Altered level of consciousness
 - Seizures
 - Hypotonia
 - Lethargy
 - High pitched cry
 - Abnormal feeding behaviour especially after a period of feeding well may be indicative of hypoglycaemia and should prompt a full clinical assessment and consideration of BG measurement. Use BAPM NEWTT2 chart BAPM Newborn Early Warning Trigger and Track Framework.
- **Jitteriness**, defined as excessive repetitive movements of one or more limbs, which are unprovoked and not in response to a stimulus, is common and is not by itself an indication to measure blood glucose.

▪ **Signs of abnormal feeding behaviour include:**

- Not waking for feeds: babies may only wake for feeds 3-5 times in the first 24 hours; after the first 24 hours babies should feed at least 8 times in 24 hours.
- Very frequent feeding: Babies who breastfeed frequently without appearing satisfied, frequent breastfeeds where baby tires rapidly or stops feeding within the first five minutes.
- Not sucking effectively: weak suck or inability to suck.

2.3 Measurement of Blood Glucose level

The quickest / most convenient way to measure BG is with a handheld blood glucose meter. These consistently underestimate the actual sugar level compared to capillary blood gas glucose (CBG). Thus, a low/borderline reading on portable glucose meter should be checked with a CBG, although treatment (e.g., with dextrose gel) should not be delayed.

Samples should be taken from a warm well-perfused heel by heel-prick, or from a free flowing venous / arterial sample, using local guidelines for skin asepsis and patient comfort. Air bubbles in capillary tubes should be avoided. Abnormal lipid or protein content in samples may reduce the accuracy of all glucose results. Do not aspirate the sample from a catheter that has had a dextrose infusion running through it.

3 Management of babies who require admission to NNU, including preterm babies, to prevent 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% glucose 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. Nasogastric or orogastric feeding may be required for babies with poor feeding (especially late preterms). 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.
5. Feed volumes may be increased to at least a "day ahead" of usual fluid requirement and may even be increased further, as tolerated.

Tube fed infants

1. Give EBM or formula milk
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 feeds.

4. Care of babies of diabetic mothers or hyperinsulinemia

- Infants of diabetic mothers are at increased risk of hypoglycaemia due to transient hyperinsulinism; the risk is reduced but not completely ameliorated by good glycaemic control.
- All infants of diabetic mothers, irrespective of the type of diabetes, should be monitored for hypoglycaemia.
- Babies should feed as soon as possible after birth and then at frequent intervals (at least every 2-3 hours).
- Blood glucose testing of babies should be carried out prior to the second feed within 4-6 hours of birth.
- If the blood glucose ≤ 2.0 mmol/L on two consecutive occasions despite maximum support for feeding, the baby should be reviewed by a paediatric doctor and given 40% dextrose oral gel up to a maximum of 3 times in 24 hrs up to 6 times in 48 hours.
- Babies of women with diabetes who present with clinical signs of hypoglycaemia should be transferred to NNU.
- Blood tests for polycythaemia, hyperbilirubinaemia, hypocalcaemia and hypomagnesaemia should be carried out on babies with clinical signs.
- As babies of diabetic women have transient hyperinsulinism, keep blood sugars above 3 mmol once they are admitted to neonatal unit for IV dextrose.

5. For management of infants with hypoglycaemia

a) Symptomatic hypoglycaemia

Or

b) Blood glucose value < 1.0 mmol/L on a single measurement

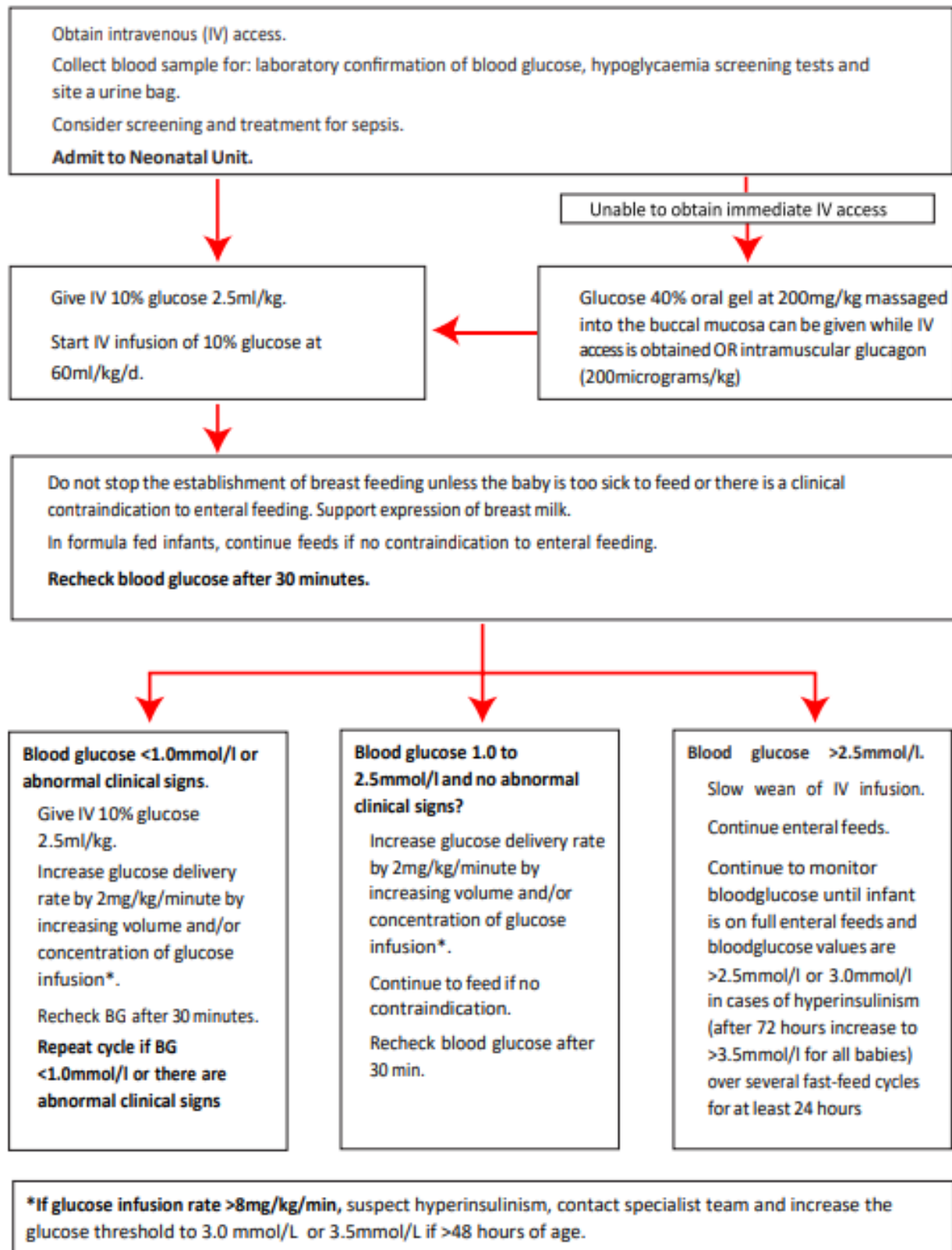
Or

c) Blood glucose values < 2.0 mmol/L on more than two occasions

despite following 'Neonatal hypoglycaemia (Management on Maternity Wards)' guideline.

Confirm blood glucose value < 2.0 mmol/L with blood gas machine, check blood for ketones and follow the flowchart below.

Management of hypoglycaemia in neonatal unit



Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant: A Framework for Practice. British Association of Perinatal Medicine, 2023.

6. Treatment of hypoglycaemia with IV dextrose

- **A bolus dose of 2.5 ml/kg 10% dextrose** may be given:
 - For any blood glucose <1.0 mmol/l
 - In any baby who is preterm and/or unwell, with a blood glucose <2.5mmol/l with symptoms.

Followed by IV infusion of 10% glucose at 60ml/kg/day

- A bolus is not normally required unless the baby is symptomatic, as boluses can provoke rebound hyperinsulinism. A bolus should never be given on its own. It must always be followed by a glucose infusion. The aim is to rapidly increase BSL to >2.0 mmol/L.
- Dextrose solutions more concentrated than 12.5% should not be infused peripherally.
- If blood glucose levels cannot be maintained by giving 12.5% dextrose at the standard rate (e.g., 60mls/kg/day on day 1), a central line (UVC/long line) to allow the administration of higher concentrations of dextrose should be considered. Simply increasing the amount of fluid given can lead to hyponatraemia and water overload.
- Use the “10 and 50” regime and online calculator to increase the concentration of dextrose (see Appendix 2).
- Glucose load should be increased in steps of 2mg/kg/min. and can be increased as high as required to keep blood glucose levels more 3 mmol/L in first 48 hrs and more than 3.5 mmol/L after 48 hrs of life.

6.1 Intravenous dextrose concentration

How to calculate mg/kg/min from ml/kg/day for any concentration of glucose (Appendix 2)

Formula: $\text{Rate (ml/kg/day)} / 144 \times \text{glucose \%} = \text{mg/kg/min}$

- Check BSL 30 minutes after initiation of treatment and then at 2 hours. Frequency of testing can be reduced if there has been an adequate response.
- Calculate glucose flow rate, monitor fluid input/output and serum sodium every 12 hourly or earlier as clinically indicated.
- A hyperinsulinaemic baby may require a glucose intake in excess of 12mg/kg/min.
- A common cause of hypoglycaemia on IV dextrose infusion with stable blood sugars is a dislodged/leaking IV line.
- Electrolytes can be added to these infusions – the total desired amount (in mmol/kg/day) added to both infusions, calculated for both as if run at the full total daily volume (mls/kg/day).

For example, 4mmol/kg/day NaCl desired at 120mls/kg/day would need 16.6mmol NaCl to be added to one 500ml bag of fluid. Therefore add 16.6mmol NaCl to BOTH the 10% dextrose and 50% dextrose bag as if each would run at 120mls/kg/day. 120mls/kg/day will be delivered by a combination of the 10% and 50% dextrose depending on the glucose load required but regardless of the final glucose concentration, 4mmol/kg/day of NaCl will be delivered –

NB if total fluid volume changes, then recalculation of added electrolytes will be required.

- If IV dextrose is needed, milk should always be continued unless there is a contraindication as enteral feeds stimulates gut hormones.
- Some babies may benefit from high energy feeds like Infatrini formula, Maxijual or SMA High Energy (Hydrolysed) for extra glucose intake. This should be discussed with the attending Consultant and (if possible) the Dietitian first
- IV dextrose should be weaned slowly so that the increase in enteral volume maintains or increases the glucose delivery.
- Once BG >2.5 mmol/L for 24 hours, reduce IV fluids and increase enteral fluids as appropriate every 6 hours, checking blood sugars 4 hourly. Once on full enteral feeds check BG every 6 hours for 24 hours, then cease testing if BG consistently >2.5mmol/L. Use clinical judgement to decide when testing can be ceased.

7. Glucose utilisation rates

Normal glucose utilisation rates are 4-6 mg/kg/min. Infants in the high-risk groups or those with other pathologies frequently require 6-10 mg/kg/min.

Infants who require >10 mg/kg/min, particularly beyond the first 48 hours of life usually have a pathological basis for their hypoglycaemia. These cases must be discussed with the Duty Neonatal Consultant and a referral to the Paediatric Endocrinology team considered.

8. Persistent or recurrent low blood glucose measurement

Persistent or recurrent hypoglycaemia (>2 measurements 1.0-1.9mmol/l during the first 48 hours after birth) can be the first presentation of an underlying disorder of glucose metabolism. Early detection of this group of infants is important because specific interventions designed to reduce the risk of brain injury may be required.

- Detailed clinical assessment and screening investigations should be performed urgently. Hyperinsulinemic hypoglycaemia is associated with several recognizable syndromes so careful clinical assessment can be done.
 - Beckwith Wiedemann syndrome
 - Turners syndrome
 - Costello syndrome
 - Prader-Willi syndrome
 - Sotos syndrome
 - Kabuki syndrome
- Non-syndromic genetic disorders of congenital HH and other rare disorders cause persistent hypoglycaemia and may require specific long-term treatment and management; these include metabolic disorders of glycogen storage, fatty acid oxidation and gluconeogenesis, hypopituitarism and adrenal insufficiency leading to deficiencies in growth hormone and cortisol.

Further special investigations are required if:

- Glucose infusion rates to prevent hypoglycaemia are persistently >12 mg/kg/min in a well grown or large for gestational age baby (small for gestational age babies quite often need high glucose infusion rates for several days).
- There is evidence of hypothalamic dysfunction such as unstable temperature or, in a boy, small or abnormal genitalia.
- Profound hypoglycaemia occurs unexpectedly in a well-grown term baby.
- Hypoglycaemia is associated with other abnormalities (e.g., exomphalos, coloboma) or suggestive of above syndromes.
- There is a family history of sudden infant death, Reye syndrome, severe developmental delay, poorly defined neuropathy or myopathy, or other evidence suggestive of an inborn error of metabolism.
- In children, circulating insulin concentrations are usually undetectable (<1 microU/l) when the blood glucose concentration is <4.5 mmol/l. In the newborn infant, up to 48 hours old, it can be normal to have circulating insulin concentrations up to 10microU/l even when the blood glucose is 3mmol/l or less. However, after this, low blood sugars with detectable insulin levels must be investigated further, in discussion with the consultant and in liaison with the Paediatric Endocrinology team.
- High insulin levels with hypoglycaemia and no urinary ketones indicates hyperinsulinism. **In hyperinsulinism, it is not unusual to have a glucose requirement of 15-20mg/kg/min or higher. Higher dextrose concentration can be given as high as needed to maintain blood glucose levels more than 3.5 mmol/L.**
- **A list of suggested initial investigations is given in Appendix 4.** Ensure that these results have been reviewed and noted prior to discharge. If any result is pending at the time of discharge, this must be mentioned in the discharge summary and communicated to the infant's named Neonatal Consultant.
- **The operational threshold should be increased to at least 2.5mmol/L in infants with moderate-severe hypoxic-ischaemic encephalopathy**

9. Management of Hyperinsulinaemic hypoglycaemia (HH)

- HH is one of the most frequent causes of persistent or recurrent low BG. It is a heterogeneous condition caused by dysregulation of insulin secretion from pancreatic beta cells. If HH is suspected, diagnosis should be made promptly by confirming high plasma insulin levels and **BG levels should be maintained >3.0 mmol/l during the first 48 hours; increasing to an operational threshold of 3.5mmol/l from day 3.** Treatment should be initiated before results from other components of the screening tests have been processed.
- Adequate carbohydrate intake at appropriate intervals must be determined prior to discharge and any pharmacological treatment required to decrease insulin secretion should be considered after discussion with Duty Neonatal Consultant and the Paediatric Endocrinologist.
- These may include such as diazoxide (starting dose 5 mg/kg/day in 3 divided doses) with chlorothiazide (5 mg/kg twice a day) or somatostatin (as octreotide, 1microgram/kg subcutaneously every 4 hours or as a continuous subcutaneous infusion

0.25micrograms/kg/hour) with glucagon by continuous IV infusion (5 – 10micrograms/kg/hour).

Diazoxide can cause both sodium and water retention causing a potential risk of both hyponatraemia or hypernatraemia and pulmonary hypertension.

Chlorthiazide is given alongside diazoxide to reduce the risk of retention, as well as potentiating its glycaemic effect. Referral by the Paediatric Endocrinologist to a centre skilled in the management of these conditions may be required.

- **High insulin levels with hypoglycaemia and no urinary ketones indicates hyperinsulinism. In hyperinsulinism, it is not unusual to have a glucose requirement of 15-20mg/kg/min. It is fine to give higher concentration of glucose as high as required via central line to maintain blood glucose levels above 3.5 mmol/L**
- **ECHO will be needed to look for any underlying congenital heart defects or pulmonary hypertension before starting Diazoxide and early discussion with Paediatric Cardiology should be considered.**

In summary, the approach to babies with persistent or recurrent low BG is:

- **Early detection by ensuring relevant appropriate screening investigations are collected;**
- **Admit to NNU to ensure that management with adequate energy provision is provided;**
- **Keep BG > 3.0mmol/l until insulin levels are known;**
- **Seek early specialist advice about additional investigations and management.**

10. Follow up

- All significantly symptomatic babies should have a test of prolonged fast (6 hours between feeds) prior to discharge.
- A small number of babies may need to go home with blood sugar monitoring.
- Parents must receive appropriate training and have follow-up arrangements.
- Infants with abnormal neurological signs and hypoglycaemia should have neurocritical care and brain MRI with long-term follow-up is recommended because of the risk of brain tissue injury and neurodevelopmental impairment in this groups.
- Further follow up requirements to be discussed with the attending consultant.

References

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- 3) Early Postnatal Care of the Moderate-Late Preterm Infant A Framework for Practice January 2023
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Appendix 1: Use of dextrose gel

Indications

- Blood glucose 1.0-1.9mmol/l in infant with no abnormal clinical signs
- Infants $\geq$ 35 weeks' gestational age and younger than 48 hours after birth
- Severe hypoglycaemia (BG $<$ 1.0mmol/L) where there is no intravenous access.

Notes

Must be given by buccal route.

- Must be used in conjunction with a feeding plan
- For babies with severe hypoglycaemia (BG $<$ 1.0mmol/l) use oral dextrose gel only as an interim measure while arranging for urgent medical review and treatment with IV glucose

Dose

- Use 200mg/kg dextrose gel (0.5 ml/kg of 40% dextrose gel), up to two doses given 30 minutes apart per episode of hypoglycaemia and a maximum of six doses of buccal dextrose gel in 48 hours.

Weight of baby (kg)	Volume of gel (ml)
1.5-1.99	1
2.0-2.99	1.5
3.0-3.99	2.0
4.0-4.99	2.5
5.0-5.99	3.0
6.0-6.99	3.5

Method of administration

- Draw up correct volume of 40% dextrose gel (Glucogel®) using a 2.5 or 5ml oral / enteral syringe
- Dry oral mucosa with gauze, gently squirt gel with syringe (no needle) onto the inner cheek and massage gel into the mucosa using latex-free gloves
- Offer a feed preferably breast milk, immediately after administering dextrose gel
- Repeat blood sugar measurement as requested
- Repeat oral dextrose gel if baby remains hypoglycaemic according to flow chart

Up to 6 doses can be given over a 48-hour period but any more than one dose should be discussed with the neonatal team; and it is advisable for the baby to be examined before the 3rd dose is administered.

Appendix 2: Intravenous dextrose concentration

How to make up any concentration of glucose in any volume:

If preprepared glucose solution is not available in the desired concentration, the desired concentration can be prepared using the following calculations:

- Desired concentration of glucose = D%
- Volume of desired concentration of glucose = V ml
- Available lower concentration of glucose = L%
- Volume of lower concentration of glucose to add = LV ml
- Available higher concentration of glucose = H%
- Volume of higher concentration of glucose to add = HV ml

Step 1: calculate the volume of higher concentration of glucose to add (HV)

$$\bullet \text{ HV (ml)} = \text{V(ml)} \times (\text{D\%} - \text{L\%}) / (\text{H\%} - \text{L\%})$$

Step 2: calculate the volume of lower concentration of glucose to add (LV)

$$\bullet \text{ LV (ml)} = \text{V (ml)} - \text{HV (ml)}$$

Step 3: Add HV and LV to get the volume of desired concentration of glucose (V)

$$\bullet \text{ V (ml)} = \text{HV (ml)} + \text{LV (ml)}$$

An example as below:

Available dextrose percentage (%)	Desired Dextrose percentage (%)	Required Fluid Volume 50 mls
50		50% dextrose needed: $V_H = 50 (12.5-10) / (50-10) = 3.12 \text{ mls}$
	12.5	
10		10% dextrose needed: $V_L = 50 - V_H = 50 - 3.12 = 46.87 \text{ mls}$

Hammersmith NICU tools (neonatal calculator) can also be used <http://www.neoweb.org.uk/>

Appendix 3: Glucagon for severe hypoglycaemia

Dose Glucagon (200mcg/kg IM) max 1mg for a single dose

Indications

- Unable to gain IV access in newly admitted infant with symptomatic hypoglycaemia
- Loss of IV access in presence of significant/symptomatic hypoglycaemia
- Persistence of hypoglycaemia despite increasing glucose infusion rate
- Presence of seizures and hypoglycaemia
- Rarely an IV bolus or infusion of glucagon might be needed. Rates of 1-18 mcg/kg/hr can be given IV or subcutaneously (max 50mcg/kg/hr)

Note: Glucagon injection is for emergency treatment and is for short term for one dose. Not indicated in SGA babies as may cause delayed hypoglycaemia

Appendix 4: Further investigation of unexplained and recurrent persistent hypoglycaemia

Perform hypoglycaemia screening for a metabolic cause in babies with severe hypoglycaemia (8mg/kg/minute (e.g., 3 measures 1.0-1.9 despite adequate top up feeds or IV fluid management >8mg/kg/minute) Screen when baby is hypoglycaemic but do NOT delay treatment and prioritise those marked “*”

Insert cannula and take 2.5 mls blood before giving IV bolus of 10% dextrose.

Essential investigation at time of hypoglycaemia

Blood Glucose *	Blood Fluoride (grey top) 0.5 mls	To confirm hypoglycaemia
Insulin / C peptide *	Blood - 1.2 ml yellow top, urgently spun & frozen On ice to lab immediately Sample for blood sugar should be taken at the same time.	Hyperinsulinism
Free fatty acids/NEFA *	Blood - 1 ml Lithium (Green top) → freeze	Hyperinsulinism
3 Hydroxy butyrate/ Blood Ketones	Blood - 1 ml Lithium (Green top) → freeze	Hyperinsulinism FAOD or disorder of ketone metabolism
Urine Ketones	Urine - ideally collect next urine passed at least 3 mls	Ketotic or non ketotic
Urine Organic acids	Urine- ideally collect next urine passed ideally 5 mls	FAOD Organic acidaemia

Consider septic screen

Investigations preferable to be done at time of hypoglycaemia

Test	Blood/Urine	Metabolic disorder
Blood gas	Blood	Organic acidaemias
Lactate	Blood- 1ml in Fluoride (Grey top)	Gluconeogenesis defects Mitochondrial disease
Amino acids	Blood- 1ml in clear (yellow top)	Organic acidaemias Liver dysfunction
Ammonia	Blood- 1ml in EDTA (purple) top rush	HIHA
Growth hormone	Blood- 1ml in clear (yellow top)	GH deficiency Hypopituitarism
Cortisol	Blood- 1ml Lithium (Green top)	Adrenal insufficiency Hypopituitarism

**Investigations for hypoglycaemia which can be done at any time
(not essential or preferred at time of hypoglycaemia)**

Test	Blood/Urine	Metabolic disorder
Acylcarnitines	Blood – 4 Dried blood spots	FAOD Organic acidaemias
Thyroid function test	Blood- 1ml in clear (yellow top)	Hypopituitarism
Liver function	Blood- 0.5 ml in clear (yellow top)	Liver failure and metabolic causes
Renal function	Blood- 0.5 ml in clear (yellow top)	Adrenal insufficiency

Appendix 5: Parent information Sheet



Maternity and Neonatal Units Frimley Park and Wexham Park Hospitals

Protecting your baby from low blood glucose

What is low blood glucose?

You have been given this leaflet because your baby is at increased risk of having low blood glucose (also called low blood sugar or hypoglycemia).

Babies who are small, premature, unwell at birth, or whose mothers are diabetic or have taken certain medication (beta-blockers), may have low blood glucose in the first few hours and days after birth, and it is especially important for these babies to keep warm and feed as often as possible in order to maintain normal blood glucose levels.

If your baby is in one of these "at risk" groups, it is recommended that they have some blood tests to check their blood glucose level. Extremely low blood glucose, if not treated, can cause brain injury resulting in developmental problems. If low blood glucose is identified quickly, it can be treated to avoid harm to your baby.

Blood glucose testing

Your baby's blood glucose is tested by a heel-prick blood test. A very small amount of blood is needed and it can be done while you are holding your baby in skin-to-skin contact. The first blood test should be done before the second feed (2-4 hours after birth), and repeated until the blood glucose levels are stable.

You and your baby will need to stay in hospital for the blood tests.

You will know the result of the test straight away.

How to avoid low blood glucose

- ☐ **Skin-to-skin contact**
Skin-to-skin contact with your baby on your chest helps keep your baby calm and warm and helps establish breastfeeding. During skin-to-skin contact your baby should wear a hat and be kept warm with a blanket or towel.
- ☐ **Keep your baby warm**
Put a hat on your baby for the first few days while he / she is in hospital. Keep your baby in skin contact on your chest covered with a blanket and look into your baby's eyes to check his / her well-being in this position, or keep warm with blankets if left in a cot.

- **Feed as soon as possible after birth**
Ask a member of staff to support you with feeding until you are confident, and make sure you know how to tell if breastfeeding is going well, or how much formula to give your baby.
- **Feed as often as possible in the first few days**
Whenever you notice "feeding cues" which include rapid eye movements under the eyelids, mouth and tongue movements, body movements and sounds, sucking on a fist, offer your baby a feed. Don't wait for your baby to cry – this can be a late sign of hunger.
 - **Feed for as long, or as much, as your baby wants.**
To ensure your baby gets as much milk as possible.
 - **Feed as often as baby wants but do not leave your baby more than 3 hours between feeds.**
If your baby is not showing any feeding cues yet, hold him/her skin-to-skin and start to offer a feed about 3 hours after the start of the previous feed.
 - **Express your milk (colostrum).**
If you are breastfeeding and your baby struggles to feed, try to give some expressed breast milk. A member of staff will show you how to hand express your milk, or watch the UNICEF hand expression video (search "UNICEF hand expression"). If possible, it is good to have a small amount of expressed milk saved in case you need it later, so try to express a little extra breast milk in between feeds. Ask your midwife how to store your expressed milk.

Don't hesitate to tell staff if you are worried about your baby

If your baby appears to be unwell, this could be a sign that they have low blood glucose. As well as doing blood tests, staff will observe your baby to check he / she is well, but your observations are also important, as you are with your baby all the time so know your baby best. It is important that you tell staff if you are worried that there is something wrong with your baby, as parents' instincts are often correct.

The following are signs that your baby is well

- **Is your baby feeding well?**
In the first few days your baby should feed effectively at least every 3 hours, until blood glucose is stable, and then at least 8 times in 24 hours. Ask a member of staff how to tell if your baby is attached and feeding effectively at the breast, or how much formula he / she needs. If your baby becomes less interested in feeding than before, this may be a sign they are unwell and you should raise this with a member of staff.

- **Is your baby warm enough?**
Your baby should feel slightly warm to touch, although hands and feet can sometimes feel a little cooler. If you use a thermometer the temperature should be between 36.5°C and 37.5°C inclusive.
- **Is your baby alert and responding to you?**
When your baby is awake, he/she will look at you and pay attention to your voice and gestures. If you try to wake your baby, they should respond to you in some way.
- **Is your baby's muscle tone normal?**
A sleeping baby is very relaxed, but should still have some muscle tone in their body, arms and legs and should respond to your touch. If your baby feels completely floppy, with no muscle tone when you lift their arms or legs, or if your baby is making strong repeated jerky movements, this is a sign they may be unwell. It can be normal to make brief, light, jerky movements. Ask a member of the team if you are not sure about your baby's movements.
- **Is your baby's colour normal?**
Look at the colour of the lips and tongue – they should be pink.
- **Is your baby breathing easily?**
Babies' breathing can be quite irregular, sometimes pausing for a few seconds and then breathing very fast for a few seconds. If you notice your baby is breathing very fast for a continuous period (more than 60 breaths per minute), or seems to be struggling to breathe with very deep chest movements, nostrils flaring or making noises with each breath out – this is not normal.

Who to call if you are worried

- In hospital, inform any member of the clinical staff.
- At home, call your community midwife and ask for an urgent visit or advice.
- Out of hours, call NHS 111 or MAMAS advice line on 0300 013 2004
- If you are really worried, take your baby to your nearest Paediatric A&E or dial 999.

What happens if your baby's blood glucose is low?

If the blood glucose test result is low, you should feed your baby as soon as possible and provide skin-to-skin contact. If the level is very low the neonatal team may advise urgent treatment to raise the blood glucose and this could require immediate transfer to the Neonatal Unit.

Another blood glucose test will be done before the next feed or within 2-4 hours. If you are breastfeeding and your baby does not breastfeed straight away, a member of staff will review your baby to work out why. If he / she is happy that your baby is well, s/he will support you to hand express your milk and give it by oral syringe / finger / cup / spoon.

If your baby has not breastfed, and you have been unable to express any of your milk, you will be advised to offer infant formula.

In some hospitals the team may prescribe a dose of dextrose (sugar) gel as part of the feeding plan because this can be an effective way to bring your baby's glucose level up.

If you are breastfeeding and advised to give some infant formula, this is most likely to be for one or a few feeds only. You should continue to offer breastfeeds and try to express milk as often as possible to ensure your milk supply is stimulated.

Very occasionally, if babies are too sleepy or unwell to feed, or if the blood glucose is still low after feeding, he / she may need to go to the Neonatal Unit / Special Care Baby Unit. Staff will explain any treatment that might be needed. In most cases, low blood glucose quickly improves within 24-48 hours and your baby will have no further problems.

Going home with baby

It is recommended that your baby stays in hospital for 24 hours after birth. After that, if your baby's blood glucose is stable and he / she is feeding well, you will be able to go home.

Before you go home, make sure you know how to tell if your baby is getting enough milk. A member of staff will explain the normal pattern of changes in the colour of dirty nappies and number of wet/dirty nappies. For further information, if you are breastfeeding, see 'How you and your midwife can recognise that your baby is feeding well' (Search 'UNICEF Baby Friendly assessment tool').

It is important to make sure that your baby feeds well at least 8 times every 24 hours and most babies feed more often than this.

There is no need to continue waking your baby to feed every 2-3 hours as long as he / she has had at least 8 feeds over 24 hours, unless this has been recommended for a particular reason. You can now start to feed your baby responsively. Your midwife will explain this.

If you are bottle feeding, make sure you are not overfeeding your baby. Offer the bottle when he / she shows feeding cues and observe for signs that he / she wants a break. Don't necessarily expect your baby to finish a bottle – let him / her take as much milk as he / she wants.

Once you are home, no special care is needed. As with all newborn babies, you should continue to look for signs that your baby is well, and seek medical advice if you are worried at all about your baby.



Frimley Health
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Please contact (PALS) the Patient Advice
and Liaison Service on:

Frimley Park Hospital

Telephone: 0300 613 6530

Email: fhft.palsfrimleypark@nhs.net

**Wexham Park &
Heatherwood Hospitals**

Telephone: 0300 615 3365

Email: fhft.palswexhampark@nhs.net

Frimley Park Hospital Portsmouth Road, Frimley, Surrey, GU16 7UJ	Heatherwood Hospital Brook Avenue, Ascot, Berkshire, SL5 7GB	Wexham Park Hospital Wexham Street, Slough, Berkshire, SL2 4HL
Hospital switchboard: 0300 614 5000		Website: www.fhft.nhs.uk

Title of Leaflet	Protecting your baby from low blood glucose Adapted from <i>Identification and Management of Neonatal Hypoglycaemia in the Full Term Infant - A Framework for Practice</i> . British Association of Perinatal Medicine, April 2017				
Frimley Health Contacts	Dr S Edate, Dr R Sanghavi, Neonatal Unit Consultants Danielle Perkins, Midwifery Matron				
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Legal Notice

Please remember that this leaflet is intended as general information only. We aim to make the information as up to date and accurate as possible. Please therefore always check specific advice or any concerns you may have with your doctor.

Full version control record

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Guidelines Lead(s):	Dr Sujata Edate, Consultant Paediatrician
Contributor(s):	Chido Mukoko, Lead Pharmacist for Women & Children, FPH
Lead Director / Chief of Service:	Dr R Sanghavi, CoS for Paediatrics & Neonates
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This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt, contact a senior colleague or expert. Caution is advised when using guidelines after the review date.

This guideline is for use in Frimley Health Trust hospitals only. Any use outside this location will not be supported by the Trust and will be at the risk of the individual using it.

Version Control Sheet

Version	Date	Guideline Lead(s)	Status	Comment
1.0	Jan 2018	Dr S Edate, Consultant Paediatrician	Final	Adapted from: Identification and Management of Neonatal Hypoglycaemia in the Full Term Infant - A Framework for Practice. British Association of Perinatal Medicine, April 2017
1.1	Dec 2021	Dr S Edate, Consultant Paediatrician	Draft	New template applied.
1.2	July 2024	Dr S Edate, Consultant Paediatrician Chido Mukoko, Lead Pharmacist for Women & Children FPH	Draft	Scheduled review. Updated extracts from reference sources
2.0	October 2024	Dr S Edate	Final	Approved at CG

Related Documents

None