



Yorkshire & Humber Pan-Network Neonatal Clinical Guideline

Title: Hyperglycaemia

Author: Hyperglycaemia ODN working group

Date written: Feb 2021

Review date: Feb 2026

This clinical guideline has been developed to ensure appropriate evidence based standards of care throughout the Yorkshire & Humber Neonatal Operational Delivery Network. The appropriate use and interpretation of this guideline in providing clinical care remains the responsibility of the individual clinician. If there is any doubt discuss with a senior colleague.

A. Guideline summary

1. Aims

To provide standardised, and evidence-based where possible, management guidelines for neonates with hyperglycaemia.

Hyperglycaemia:

- blood glucose > 12mmol/L and glycosuria +++
- 2 blood glucose readings of > 12 mmol/L
- one off blood glucose > 15 mmol/L



Confirm blood glucose level on blood gas machine



- Exclude underlying causes (eg infection, pain)
- Monitor urine glucose and volume (ml/kg/hr)
- Calculate glucose delivery rate

On IV Fluids

Change IV fluids to 5% dextrose aiming for GDR 6-10mg/kg/min

If hyperglycaemia persists → start insulin infusion

**please see appendix*

On PN

Start insulin infusion

**please see appendix*



Monitor blood glucose hourly for the first 4 hours and then 2-4 hourly, until sugars are stable.

Follow insulin infusion protocol

**please see appendix*

If blood glucose remains consistently >20mmol/L despite appropriate insulin delivery, consider stopping PN

B Full guideline and evidence

1. Background

Hyperglycaemia is a common problem in the preterm infants (< 29 weeks) and very low birth weight infants (VLBW), estimated to occur in 45-80% of these infants, especially within the first 72 hours.

There are multiple factors contributing to hyperglycaemia. It can be in part a stress response, but also due to reduced islet cell function and relative insulin resistance. It is associated with significant morbidity and mortality, though the exact level of plasma glucose causing damage is unknown.

Hyperglycaemia is problematic both short term due to it causing an osmotic diuresis therefore hypernatraemic dehydration; but also, longer term is associated with NEC, ROP, IVH, prolonged periods of ventilation, late onset sepsis, BPD and prolonged hospital stay.

2. Aim

To provide standardised, and evidence-based where possible, management guidelines for neonates with hyperglycaemia.

3. Evidence

3.1 Risk factors for hyperglycaemia:

- Pain
- Stress
- Sepsis
- Hypoxia
- Drugs (Steroids, phenytoin, caffeine)
- Administration error
-

3.2. Definition of hyperglycaemia

There is no universal consensus on definition of neonatal hyperglycaemia, with values ranging from greater than 6.9 to greater than 12mmol/L. Definition used commonly, which would need treatment, is as below:

- Blood glucose > 12mmol/L and glycosuria +++
- 2 blood glucose readings of > 12 mmol/L
- One off blood glucose > 15 mmol/L

It is important to confirm diagnosis by repeating blood glucose on blood gas machine.

3.3. Management of hyperglycaemia

- Confirm the diagnosis by repeating blood glucose on the gas machine.
- Monitor urine for glycosuria and urine volume (ml/kg/hr) to ensure adequate fluid balance. If baby needs additional fluids to counter renal and extrarenal losses, consider using 5% glucose or 0.45% sodium chloride.

- Exclude risk factors of hyperglycaemia and act accordingly:
 - Pain
 - Stress
 - Sepsis
 - Hypoxia
 - Medications (Steroids, phenytoin, caffeine)
 - Maternal medication (diazoxide)
 - Administration error (Check the administration equipment and ensure that the fluid the baby has received is being administered at the correct rate and volume)
- If feeding is safe, start feeds as early as possible. It has been noted that even minimal enteral feeds induce insulin secretion.
- Calculate Glucose Delivery Rate (GDR)

$$\text{Glucose infusion rate (mg/kg/min)} = \frac{\text{rate of fluid (ml/kg/day)} \times \text{Glucose concentration (\%)}}{144}$$

Or use Calculator can be found at: www.NICUtools.org

3.3.1 Babies on IV fluids

- If glucose delivery rate is >10mg/kg/min, consider weaning it gradually (by 1-2mg/kg/min every 2-4 hours) to 6 - 10mg/kg/min. It is more appropriate to reduce glucose concentration than overall rate as dehydration due to osmotic diuresis is a risk. (Reducing the glucose concentration of drug infusions should be prioritised)
- If glycosuria and hyperglycaemia persist despite an appropriate glucose infusion rate, commence insulin via separate venous access (peripheral or central)

3.3.2 Babies on PN

When babies are reliant on their intravenous infusions for nutrition there are additional considerations needed prior to reducing carbohydrate delivery. Not only does reducing the carbohydrates reduce overall calorie delivery, but it also changes the non-protein calorie lipid:carbohydrate ratio, and reduces the body's ability to effectively utilise protein.

❖ In these babies, insulin should be used preferentially prior to reducing carbohydrate delivery.

PN should continue unless the rates of insulin are >0.2units/kg/hr. A rate of >0.2units/kg/hr is suggestive of insulin resistance, and in these instances a reduction in the glucose delivery rate may be necessary. This should be discussed with the attending consultant, neonatal dietician and pharmacist and adjustments made to the PN prescription.

3.3.3 Insulin management:

Insulin should be used to treat hyperglycaemia as described above following the flow chart. It is recognised that there are different regimens for titrating insulin dosage to control blood glucose levels with limited evidence available to support one regimen over another.

The Neonatal ODN recommends use of the protocol in appendix 1 but is aware that there are other safe and effective protocols in practise within the region. An example insulin prescription chart for the protocol in Appendix 1 is provided in Appendix 2.

Infants needing more than 0.2 units/kg/hour of insulin is suggestive of insulin resistance, and a reduction in glucose delivery may be needed. It is also important if blood glucose is not falling as expected or the insulin infusion rate is 0.2 units/kg/hour or more to ensure appropriate insulin delivery eg. make sure iv access is working properly, check iv site, ensure no filter in the line, ensure drugs are compatible etc so you are actually able to deliver the amount of insulin you need to and discuss with the on-call consultant.

Monitor potassium and phosphate levels as insulin will cause reduction in serum concentration due to intracellular shift.

4. Audit Criteria

5. References

1. Neonatal Hyperglycemia -Causes, Treatments, and Cautions. Neonatal Hyperglycemia-Causes, Treatments, and Cautions - PubMed (nih.gov)
2. Computer-determined dosage of insulin in the management of neonatal hyperglycaemia (HINT2): protocol of a randomised controlled trial
3. Neonatal Hyperglycemia, which threshold value, diagnostic approach and treatment?: Turkish Neonatal and Pediatric Endocrinology and Diabetes Societies consensus report
4. Tight Glycemic Control With Insulin in Hyperglycemic Preterm Babies:A Randomized Controlled Trial
5. Gomella 8th Edition
6. Neonatal hyperglycaemia (Uptodate)
7. Interventions for treatment of neonatal hyperglycaemia in very low birth weight infants (cochrane review)
8. Prevalence and determinants of hyperglycaemia in VLBW infants: cohort analyses of NIRTURE study
9. Management of hyperglycaemia in the preterm infant. Arch Dis child fetal neonatal Ed 2010; 95 (2): F126-31
10. Neonatal hyperglycaemia. Hemachandra et all 1999 AAP
11. Management of hyperglycaemia in the neonate. 2020. LTHT ID 631.
12. Management of neonatal hyperglycaemia. 2017. The Yorkshire and Humber Neonatal operational delivery network.

6. Working group

Dr Aoife Hurley, Neonatal grid trainee
 Dr Fadi Maghrabia, Paediatric trainee
 Dr Jo Preece, Consultant Neonatologist, Hull Royal Infirmary
 Dr Cath Smith, Consultant Neonatologist, Jessop Wing Sheffield

Appendices

Appendix 1 - ODN recommendation for Insulin Management.

Starting rate of insulin: 0.04units/kg/hour

Different strength insulin can be used, to allow concentration of insulin infusion and therefore reduce additional fluid intake on top of daily requirements.

Blood glucose to be documented, with current insulin dose and any changes to insulin doses, prescribed by a doctor or ANNP.

- If BG > 12 mmol/L and not reducing → increase the rate of insulin by 0.02 units/kg/hr
- Check blood glucose within one hour of starting
- Increase by 0.02 units/kg/hr until blood glucose decreasing by at least 1mmol/l between blood samples
- If blood glucose not falling as expected, and/or an insulin infusion rate of 0.2units/kg/hour is required, ensure appropriate insulin delivery eg. Check pump, check lines and iv site, ensure no filter, ensure compatible with other infusions
- Target blood glucose whilst on insulin is 7 to 12 mmol/l
- To prevent hypoglycaemia, if blood glucose is :
 - 7-12 mmol/L and stable → keep the insulin running at **same rate**.
 - 7-12 mmol/L and decreasing → **reduce** the rate of insulin by **0.02 units/kg/hr**.
 - 4- 6.9 mmol/L → reduce insulin infusion rate by 50%,or stop if on lowest infusion rate
 - If BG < 4 mmol/L at any point → **stop insulin immediately**.
 - Keep monitoring BG for 12 - 24 hours after stopping the insulin

Appendix 2 Example insulin prescription chart

**** Use Low Sorbing extension sets****Do NOT use a filter****

Insulin Infusion for Neonates

Before commencing insulin infusion ensure that ALL the following have been checked

1. Blood glucose >12mmol/L with glycosuria +++ or more
2. 2 blood glucose readings >12mmol/L
- Or Blood glucose ≥ 15 regardless of urine glucose
3. Glucose intake < 10mg/kg/min

Glucose conversion
 $\frac{\text{mls/kg/day} \times \% \text{ glucose}}{144} = \text{mg/kg/min}$

Name : DoB: _____ (Affix Patient Label Here)

Hosp No.: NHS No.: _____

Consultant: _____

Working weight _____ kg

If the volume of the insulin infusion represents a substantial proportional of daily fluid intake the concentration of insulin should be increased and volume decreased accordingly

Single Strength Insulin Infusion

0.1 unit in 1 mL

Add 5 units of insulin to 50ml glucose 5%

Double Strength Insulin Infusion

0.2 units in 1 mL

Add 10 units of insulin to 50ml glucose 5%

Quadruple Strength Insulin Infusion

0.4 units in 1 mL

Add 20 units of insulin to 50ml glucose 5%

- Commence infusion at **0.04 units/kg/hour**
- Check blood glucose within one hour of starting
- Increase by **0.02 units/kg/hr** until blood glucose decreasing by at least 1mmol/l between blood samples
- **If blood glucose not falling as expected, and/or an insulin infusion rate of 0.2units/kg/hour is required, ensure appropriate insulin delivery eg. Check pump, check lines and iv site, ensure no filter, ensure compatible with other infusions**
- Target blood glucose whilst on insulin is **7 to 12 mmol/l**

Date and time	Strength of infusion	Amount of insulin required	Prescriber's Signature & Bleep No.	Batch number and expiry date of glucose 5%	Batch number and expiry date of insulin	Expiry date and time of infusion	Prepared by / Checked by
		units					
		units					
		units					
		units					

To prevent hypoglycaemia if blood glucose is **7 to 12 mmol/l and stable**

7 to 12 mmol/l and decreasing

4 to 6.9 mmol/l

<4 mmol/l

Recheck blood glucose within 1 to 2 hours of reducing the dose, then check every 2 to 4 hours until stable

- maintain infusion rate
- reduce infusion rate by 0.02 units/kg/hr
- reduce infusion rate by 50% from present rate, or stop if on lowest infusion rate
- stop infusion

