Management of Hyperglycaemia on the Neonatal Unit

University Hospitals of Leicester NHS
NHS Trust

Trust ref: C26/2006

Contents

1. Introduction and Who Guideline applies to

This guideline is aimed at all health care professionals involved in the care of infants within the Neonatal Service, University Hospitals of Leicester. It provides recommendations for the management of hyperglycemia in preterm infants.

Key points

- Continuous insulin infusions can achieve glycaemic control, increased caloric intake and weight gain especially in extremely low birth weight infants.

Aims

1. To identify and treat underlying aetiology (e.g. infection, hypoxia, stress response, pain, medications and tailor parenteral glucose administration).
2. To prevent acute complications of hyperglycaemia (osmotic diuresis and associated fluid and electrolyte imbalance).
3. To maintain euglycaemia (5-8 mmol/L) and adequate caloric intake without causing hypoglycaemia

Related UHL documents:

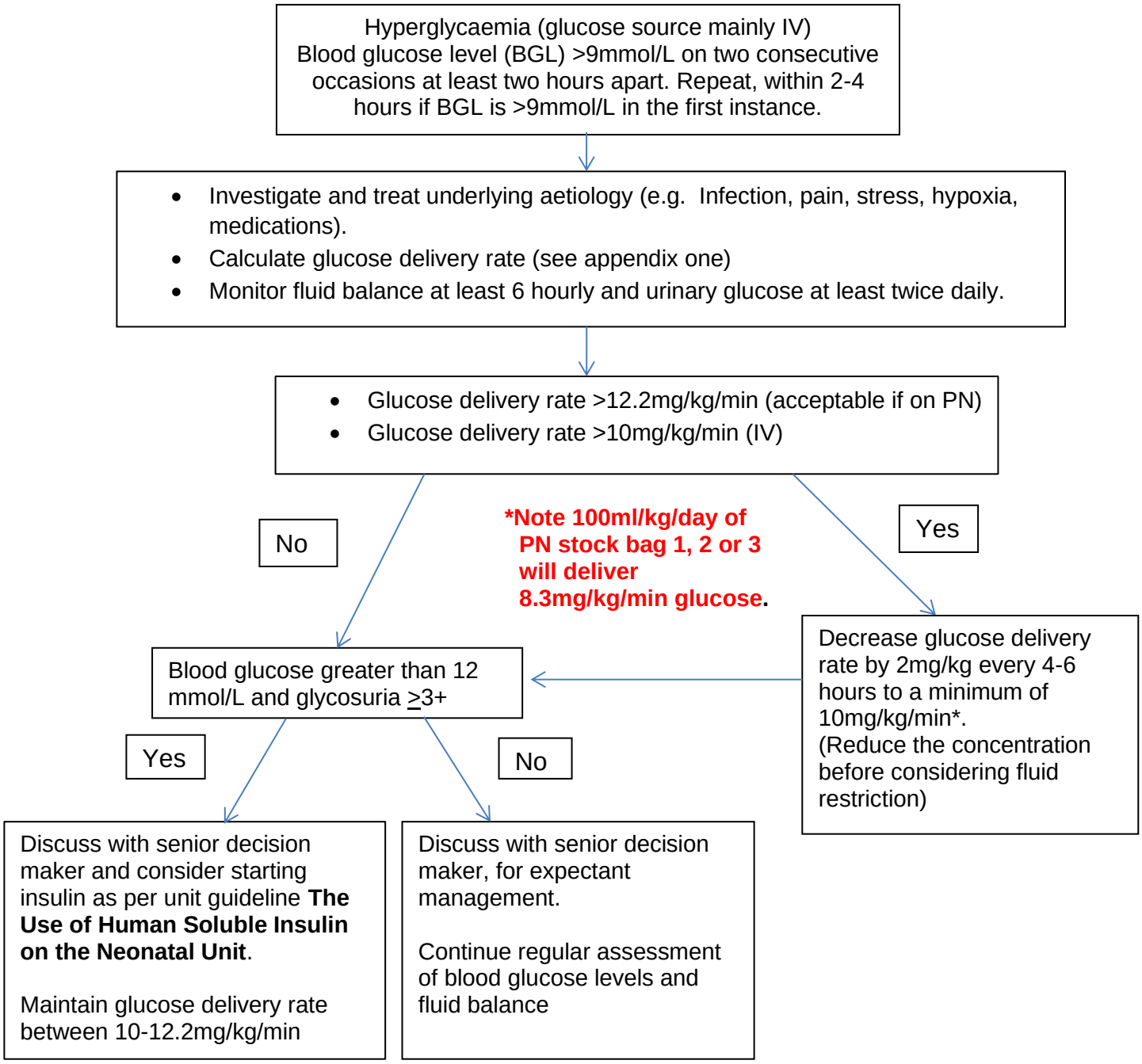
Insulin use on the neonatal unit Trust ref: C25/2006

2. Guideline Standards and Procedures

Neonatal Hyperglycaemia

There is no established definition of neonatal hyperglycaemia. However, blood glucose levels > 12mmol/L accompanied by severe (3+ or greater) glycosuria may warrant treatment especially in sick preterm infants. If glycosuria is not severe (<3+) continue to monitor urine glucose frequently. See flowchart 1 for summary of approach to treatment.

Flowchart 1 – treatment of neonatal hyperglycaemia



Background

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.

Evidence suggests that prolonged periods of **both** hypo and hyperglycaemia include an increased risk of complications including retinopathy of prematurity, germinal matrix-intraventricular haemorrhage and adverse neurodevelopmental sequelae.

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 in-utero delivery is 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, levothyroxine, thiazides, steroids and phenytoin are also known to cause hyperglycaemia.

Active management strategies include carbohydrate restriction or intravenous insulin infusion or both. There is limited evidence about the long term benefits of these two approaches however there is some evidence that the use of insulin to treat established hyperglycaemia helps to maintain nutritional intake and improve growth, including head growth, in the neonatal period. 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. Provision of sufficient protein intake through parenteral amino acids may help manage hyperglycaemia by increasing insulin secretion and maintaining glucose homeostasis. In addition, enteral feeding stimulates the pancreatic release of insulin as part of the digestive process.

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 (summarised in flow chart 1)

- The preferred method of measuring blood glucose is the gas machine. Where this is unavailable an alternative glucose oxidase method should be used. Lab glucose values should only be used for acknowledging trends not for directing management.

- 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 ≥6mg/kg/min and additional fluids are needed to counter renal and insensible losses 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. Blood glucose may be transiently raised following a stressful event such as reintubation or line insertion**.** If the hyperglycaemia may have been caused by such an intervention it is reasonable to repeat the measurement before initiating treatment. The interval between the initial sample and the repeat will be determined by the level of blood glucose and the rate of rise.

- Calculate glucose delivery rate using the following formula or the glucose rate calculator in Appendix 1

Glucose infusion rate (mg/kg/min) = concentration of dextrose (%) x flowrate (ml/kg/day) ÷144

Remember to include all sources of energy intake: infusions (glucose) and enteral intake (carbohydrate)

- If glucose delivery rate is >10mg/kg/min (IV) or >12.2 mg/kg/min (PN), decrease glucose intake (by 2 mg/kg/min every 4-6 hours) to 10 mg/kg/min. Reduce the glucose concentration before considering fluid restriction. Monitor the falling blood glucose level. For more guidance, please see the UHL NNU Guideline: The Use of Human Soluble Insulin on the Neonatal Unit, Appendix 1: Adjusting insulin rates in response to blood glucose trends.

- 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. Take care with further glucose restriction as intakes of <6mg/kg/min may result in significant catabolism.

- Monitor blood glucose hourly in the first 4 hours and 2 hourly dependent on blood glucose stability until euglycaemia (5-8 mmol/L) is achieved.

- The glucose delivery rate should be maintained at 10-12.2 mg/kg/min during insulin infusion to promote caloric intake, weight gain and prevent hypoglycaemia

- Where adequate control of hyperglycaemia cannot be achieved with the approaches above a consultant should direct whether to further reduce glucose intake, balancing the risks of persistent hyperglycaemia against the risks of

restricted calorie and macronutrient intake. For infants on PN a reduction in glucose delivery rates can be achieved by:

- Reducing the concentration of any supplementary glucose infusions
- Reducing the volume of any supplementary glucose infusion if fluid balance allows
- Reducing the volume of PN infused (stock bags 1,2,3 contain 12% glucose) and making up the fluid deficit with 5% glucose
- Ordering bespoke PN with a lower glucose concentration – note the amino acid and fat content of the bespoke PN would also require reducing if used beyond 2-3 days.

4. Education and Training

None

5. Audit Criteria

1. Monitor blood glucose hourly in the first four hours and 2 hourly dependant on blood glucose stability until euglycaemia (5-8mmol/L) is achieved

6. Supporting References

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7. Key Words

Insulin, Glycosuria, Blood glucose, Glucose

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

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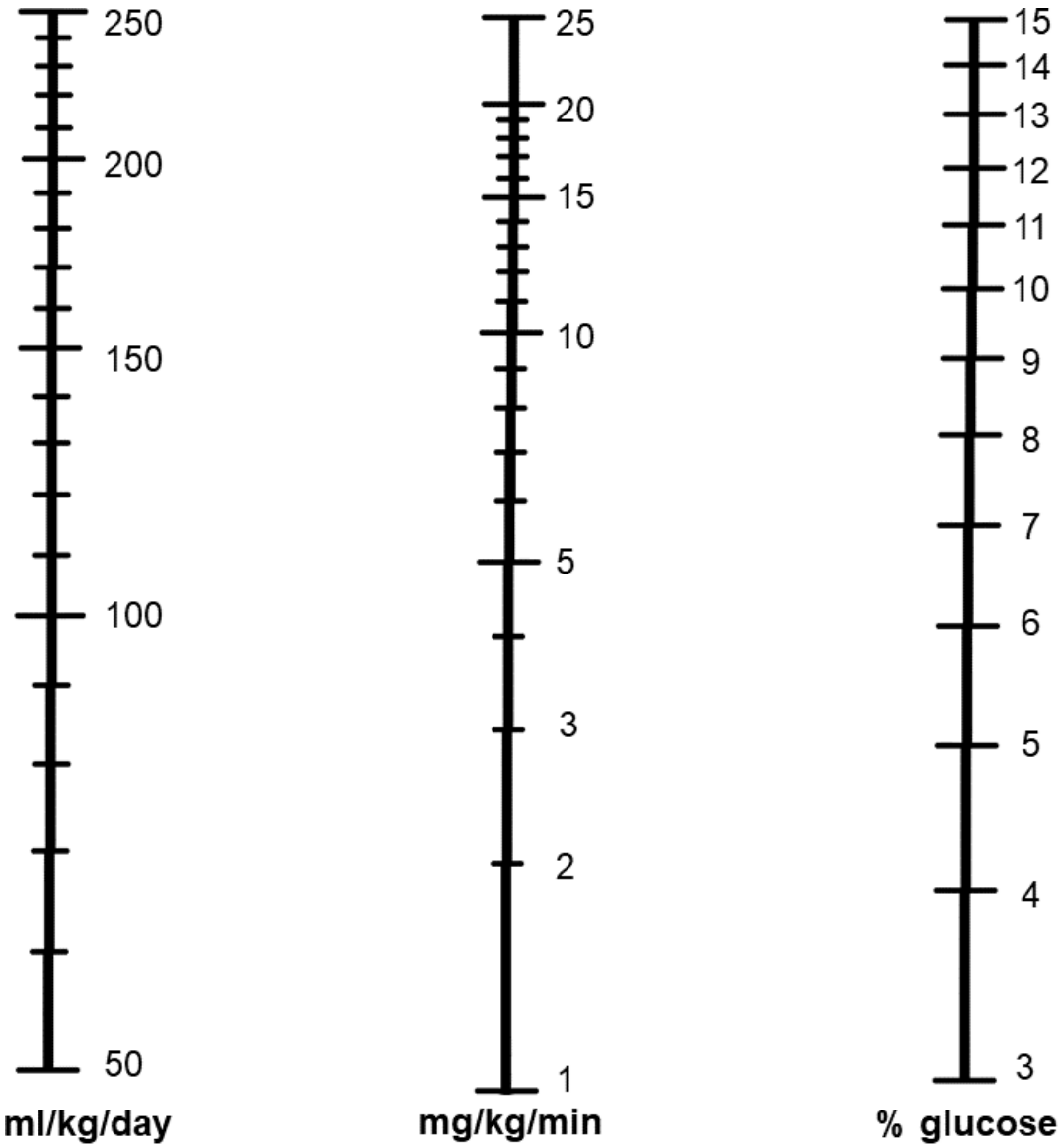
We are also committed to delivering services that ensure our patients are cared for, comfortable and as far as possible meet their individual needs.

Contact and review details			
Guideline Lead (Name and Title) V Kairamkonda - Consultant Lucy Stachow - Pharmacist			**Executive Lead** Chief Medical Officer
Details of Changes made during review:			
Date	**Issue Number**	**Reviewed By**	**Description Of Changes (If Any)**
Dec 2005	**1**		New Guideline
Jan 2009	**2**		Guideline Review
Jan 2016	**3**	Review by author (VK) Neonatal Governance Meeting Reviewed by audit group	no significant change to evidence
Jan 2019	**4**	Authors VRK / LS and guidelines lead REM Neonatal Governance Meeting	Minor changes only
Jan 2022 – Mar 2022	**5**	Reviewed by VRK/LS & Alice Kavati – Advanced Neonatal Nurse Practitioner Neonatal Governance meeting	Glucose delivery rate from PN amended to reflect current PN policy. Senior decision maker replaces consultant in flowchart. Details of options to reduce glucose infusion in patients on PN added.
March 2025	**6**	Reviewed by VRK/LS & Alice Kavati – Advanced Neonatal Nurse Practitioner Neonatal Governance meeting	Minor amendment especially in flow sheet and assumptions with respect to the carbohydrate content of enteral feeds

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)

Appendix 2: Assumptions with respect to the carbohydrate content of enteral feeds

(As per Ms. Rachel Fox, Senior Specialist Paediatric Dietitian UHL).

Type of Infant Milk	Carbohydrate (g)/100ml
Expressed Breast Milk	7.2
Donor Expressed Breast Milk	6.6
Expressed Breast Milk (Fortified)	8.8
Nutriprem 1	8.4
Nutriprem 2	7.2
Standard formula	7.3
Pepti-Junior	6.9
Infatrini	10.3
Infatrini Peptisorb	10.2
SMA HE	10