HYPOGLYCAEMIA MANAGEMENT FOR NON-DIABETIC PATIENTS

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Hypoglycaemia is a medical emergency
- Hypoglycaemia = blood glucose level (BGL) < 2.6mmol/L (< 3mmol/L if symptomatic).
- Check initial capillary BGL in any significantly unwell child, do it early.
- Investigation of hypoglycaemia requires 6.5mL blood and 10-20mL urine.
- Powerchart/FirstNet order sets exist for workup of hypoglycaemia
- Treat hypoglycaemia with 2mL/kg of 10% glucose intravenously if not able to treat orally

CHANGE SUMMARY

- Revised pathology collection requirements
- Minor changes to text to aid interpretation
- Glucagon dosing revised

READ ACKNOWLEDGEMENT

- Clinical staff caring for non-diabetic hypoglycaemia patients are to read and acknowledge they understand the contents of this document.

Approved by:	SCHN Policy, Procedure & Guideline Committee	
Date Effective:	5th February 2024	**Review Period**: 3 years
Team Leader:	Consultant	**Area/Dept**: SCH Endocrinology

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Definition

- Hypoglycaemia = blood glucose level (BGL) < 2.6mmol/L (< 3mmol/L if symptomatic).
- Patients should be triaged to an area where they can be closely observed.
- Check initial finger prick capillary BGL and ketones (by glucometer) in any unwell child who has persistent vomiting, prolonged fasting, symptoms of hypoglycaemia, reduced level of consciousness or there is clinical concern. Check it early.

Symptoms

(NB: may be none of the following; simply an unwell child)

CNS effects	Adrenergic Release
• Apnoea	• Tremors
• Cyanosis	• Hunger
• Hypotonia	• Sweating
• Coma	• Pallor
• Seizures	• Weakness
• Headache	• Tachycardia
• Irritability	• Anxiety
• Confusion	
• Blurred vision	

Investigations

These investigations should be performed on **all patients** (including neonates) **with a BGL <2.6 mmol/L prior to the administration of glucose** but should not delay treatment in symptomatic patients.

If possible, if asymptomatic, ideally check that the BGL is also <2.6 mmol/L (or <3 mmol/L if symptomatic) on the *venous blood gas* (VBG) before sending the additional blood tests.

Blood tests may be omitted in newborns < 24hrs age at the discretion of treating specialist.

Blood

- Glucose
- Lactate
- Beta-hydroxybutyrate
- Cortisol
- Free fatty acids
- Insulin*
- C-peptide
- Growth hormone
- Acylcarnitine profile
- Bedside ketone test using point of care device (ketone strip in glucometer)
- Ammonia (does not need to be collected at time of hypoglycaemia if blood sample limited)
- CK (does not need to be collected at time of hypoglycaemia if blood sample limited)
- Venous blood gas
- Consider workup for sepsis (e.g., FBC, cultures etc) if clinically indicated since sepsis can present as hypoglycaemia

(refer to the NSW Health Pathology Test Catalogue for more information) **SEALS assay only detects endogenous insulin and not insulin analogues (especially important in adolescents with unexplained hypoglycaemia).*

At CHW

- Order set in PowerChart/FirstNet called "**Hypoglycaemia - Child**" or "**Hypoglycaemia - Neonate**" (up to 28 days of age)
- All blood tubes must *immediately* be placed on **ice** in a specimen bag and transported to the lab **urgently** (via pneumatic tube system or carried).

At SCH

- Order set in PowerChart/FirstNet called "**Paed ED hypoglycaemia**"
- All blood tubes must *immediately* be placed on **ice** in a specimen bag and transported to the lab **urgently** (via "Scud" airtube system only).

Urine *(CHW & SCH)*

- Bedside urinalysis dipstick test for reducing substances / ketones / glucose
- 10-20 mL for urine metabolic screen – collect first urine passed after hypoglycaemic episode. Bag urine or cotton wool in nappy is appropriate.

Management

NB: Do not delay management in order to collect specimens if symptomatic

- **If conscious and tolerating oral intake** then treat with age appropriate oral glucose:
  - **<1 month:**
    - 0.5mL/kg 40% oral glucose gel[5]
    - Administered into the buccal mucosa (not orally or via NG)
  - **1 - < 12 months:**
    - 1mL/kg 40% oral glucose gel (gives 0.4g/kg glucose)[4]
      - Gel can be administered into buccal cavity, orally or via NG with flush
      - If >6 months can also give 60mL juice
  - **1 – 5 years:** 60mL juice (7.2g glucose)
  - **> 5 years:** 125mL juice (15g glucose)

  Note: 10% glucose IV solution can also be given via NG tube at 2mL/kg if unable to gain IV access but will tolerate NG feeds

- **If impaired consciousness or not tolerating oral intake, then bolus slowly over at least 5 mins 2mL/kg of glucose 10% IV (DO NOT bolus with glucose 50%).**
  - **Following IV bolus, commence maintenance intravenous fluids made up to glucose 5-10% (max 10% peripherally) aiming for BGL 4-8 mmol/L**.

- **If impaired consciousness and not able to gain IV access**, consider IM glucagon (*reconstitute 1 mg vial by adding 1 mL diluent (WFI) provided = 1 mg/mL conc.*)
  Use reconstituted* solution (1mg/mL) immediately as per the doses listed below:

  Dose = 200 microg/kg/dose (not exceeding 1 mg/dose).

  Doses can be estimated as follows (AMH-CDC, PIMH):
  - **≤ 25 kg or < 5 yrs (if unknown weight):** 0.5mg = (0.5 mL = ½ of reconstituted* vial solution)
  - **> 25 kg or > 5 yrs:** 1mg = (1 mL = full contents of the reconstituted* vial solution)

- Treat the underlying cause if known – e.g., sepsis, hypothermia, dehydration.
- *Recheck the BGL frequently* (e.g., every 15 minutes, then 30 minutes, then hourly) until BGL stabilises.
- **ALL children** presenting to the ED with hypoglycaemia require admission.
  - At SCH this will be a ward admission usually under the General Medical Team.
  - At CHW, this will usually be a General Medical Team admission, however, relatively well children with mild hypoglycaemia could be considered for an Emergency Department Short Stay Unit (EDSSU) admission. Discuss with supervising ED consultant or fellow in this situation.

If continuing hypoglycaemia or infusion rate of glucose above 8 mg/kg/min, discuss with Endocrinologist on call, as may require hydrocortisone (particularly in the neonatal period) or IV glucagon infusion with monitoring in ICU.

Glucose infusion rate (GIR)

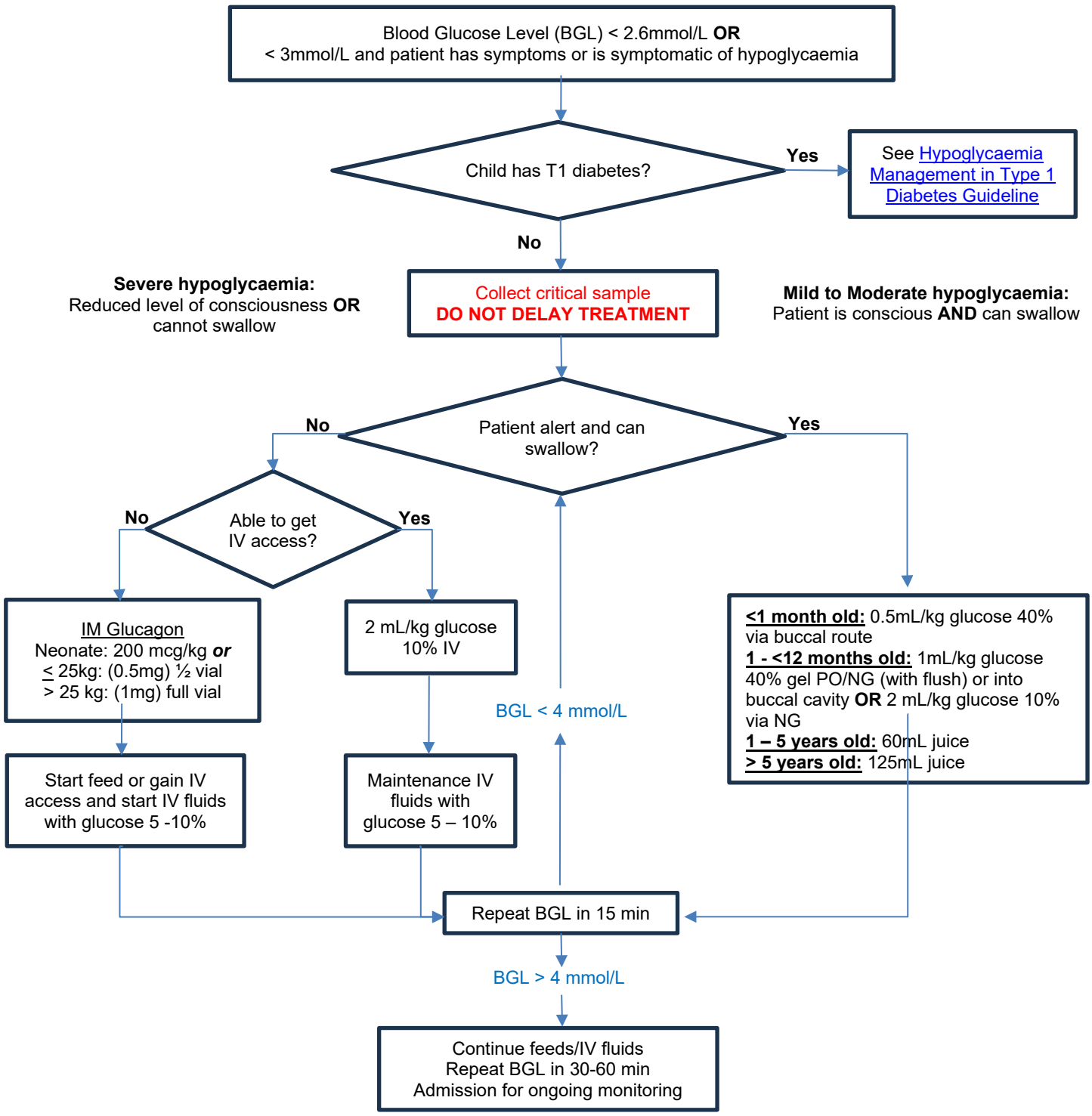
$$\text{GIR} = \frac{(\text{Glucose Concentration, \%}) \times (\text{Infusion rate, } mL/hr) \times (1000\ mg/g)}{(\text{Weight, } kg) \times (60\ min/hr) \times 100}$$

NB: *Glucagon will only elevate blood glucose acutely in hyperinsulinism if there are good glycogen stores.*

Glucose Homeostasis

During fasting, several metabolic systems (glycogenolysis, proteolysis, gluconeogenesis, lipolysis and ketogenesis) are activated to convert energy stores (glycogen, protein and triglycerides) into fuels (glucose, ketones and fatty acids) that other tissues can use. Growth hormone (GH), cortisol, adrenaline and glucagon activate whilst insulin inhibits these fasting systems.[1-3]

NB: Do not delay management in order to collect specimens if symptomatic



Causes of Hypoglycaemia

Hypoglycaemia	Cause
Idiopathic ketotic hypoglycaemia / accelerated starvation	• age between 1-6 years, more commonly in Caucasian children • hypoglycaemia with elevated blood and urine ketones • hypoglycaemia occurs after fasting (early AM, intercurrent illness) • thought to be due to a lower rate of endogenous glucose production
Defects in glycogenolysis	• Glycogen storage disease
Defects in gluconeogenesis	• Hereditary fructose intolerance • Ethanol intoxication • Fatty acid oxidation disorders • Glutaric acidemia type 2 • Carnitine deficiencies
Counter-regulatory hormone defects	• GH deficiency • Cortisol deficiency • Hypopituitarism • B blocking agents
Hyperinsulinism (absence of ketones)	• Infants of diabetic mothers • Hyperinsulin syndrome • Beckwith-Wiedemann syndrome • Dumping syndrome • Liver disease
Exogenous	• Medications e.g., diabetes medications, beta blockers
Substrate deficiency	• Prolonged fasting (includes prolonged vomiting illness) • Restrictive eating • Sepsis • Malnutrition

Ketotic hypoglycaemia is the most common cause of hypoglycaemia under 2 year of age. **This diagnosis requires ketonuria or ketonaemia**. However, the presence of ketones does not exclude a different cause so the above investigations are still required.

Resources

- AMH-CDC Glucagon: https://childrens.amh.net.au.acs.hcn.com.au/monographs/glucagon
- PIMH Glucagon: http://injectables.webapps.schn.health.nsw.gov.au/browse/glucagon
- ANMF: https://www.anmfonline.org/wp-content/uploads/2021/06/glucose-40-20062019-2.0.pdf

Reference

1. Hoe F, Hypoglycaemia in Infants and Children, Advances in Pediatrics 2008 55; 367-384
2. Thornton PS, Stanley CA, De Leon DD, Harris D, Haymond MW, Hussain K, et al. Recommendations from the Pediatric Endocrine Society for Evaluation and Management of Persistent Hypoglycemia in Neonates, Infants, and Children. J Pediatr. 2015;167(2):238-45
3. Achoki R, Opiyo N, English M. Mini-review: Management of hypoglycaemia in children aged 0-59 months. J Trop Pediatr. 2010;56(4):227-34.
4. Abraham MB, Karges B, Dovc K, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Assessment and management of hypoglycemia in children and adolescents with diabetes. Pediatr Diabetes. 2022;23(8):1322-1340. doi:10.1111/pedi.13443
5. Harris DL, Weston PJ, Signal M, Chase JG, Harding JE. Dextrose gel for neonatal hypoglycaemia (the Sugar Babies Study): a randomised, double-blind, placebo-controlled trial. Lancet 2013;382(9910):2077–83