# 3.8.7. Hypoglycaemia

## 3.8.7. Neonatal Hypoglycaemia

## Learning goals

After this chapter you should be able to: define neonatal hypoglycaemia; list risk factors and clinical features; use **operational thresholds** across the first 48 hours and beyond; write a **step-wise management plan** (breastfeeding support, 40% dextrose gel, IV dextrose, escalation); outline evaluation for **persistent hypoglycaemia** (critical sample, hyperinsulinism); and document safe discharge and counselling.

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## 1) What is neonatal hypoglycaemia?

Hypoglycemia is difficult to define in neonates but is generally considered a serum glucose concentration < 40 mg/dL (< 2.2 mmol/L) in symptomatic term neonates, < 45 mg/dL (< 2.5 mmol/L) in asymptomatic term neonates between 24 hours and 48 hours of life, or < 30 mg/dL (< 1.7 mmol/L) in preterm neonates in the first 48 hours. Risk factors include prematurity, being small for gestational age, maternal diabetes, and perinatal asphyxia. The most common causes are deficient glycogen stores, delayed feeding, and hyperinsulinemia. Signs include tachycardia, cyanosis, seizures, and apnea. Diagnosis is suspected empirically and is confirmed by glucose testing. Treatment is enteral feeding or IV dextrose. Prognosis depends on the underlying condition.

Modern practice uses **“operational thresholds”** that trigger action and depend on **hours of age** and **clinical context**. For **at-risk or symptomatic** late-preterm/term infants, commonly used AAP operational thresholds are:

- **0–4 h:** treat if plasma glucose (**PG**) **<25–40 mg/dL** (1.4–2.2 mmol/L).
- **4–24 h:** treat if **<35–45 mg/dL** (1.9–2.5 mmol/L).
- **≥24 h:** aim **≥45 mg/dL** (≥2.5 mmol/L).

After the **transitional period**, the **Pediatric Endocrine Society (PES)** recommends maintaining **>50 mg/dL** in the first **48 h** and **>60 mg/dL after 48 h**; if a **hypoglycaemia disorder** is identified (e.g., hyperinsulinism), target **>70 mg/dL**.

> **Key idea for exams:** thresholds vary between bodies (AAP, BAPM, CPS, PES); **state your source** and stick to its algorithm.

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## 2) Why it happens (pathophysiology)

At birth, glucose falls physiologically as the placenta is cut; values may reach ~**20–25 mg/dL** at 1–1.5 h then rise with feeding and endogenous production. Risk arises when **supply is insufficient** (poor intake, prematurity), **consumption is high** (sepsis, hypothermia), or **insulin is excessive** (IDM/hyperinsulinism).

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## 3) Who needs screening?

**At-risk neonates:**

- **Late preterm** (34–36+6 weeks), **SGA**, **LGA**, **IDM** (infant of diabetic mother), **perinatal stress/asphyxia**, **cesarean without labour**, **polycythaemia**, **hypothermia**, **sepsis**, **poor feeding**, **maternal β-blockers**. Screen pre-feed from 2 h of age and 3–6-hourly while at risk.

Healthy term babies **without risk** need not be routinely screened.

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## 4) Clinical features (don’t miss subtle ones)

- **Subtle:** jitteriness/tremors, high-pitched cry, poor feeding, lethargy, hypotonia, hypothermia.
- **Serious:** apnoea, cyanosis, tachypnoea, seizures, coma.
  Any **symptom → check glucose immediately** and treat empirically while confirming in lab.

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## 5) Measuring glucose correctly

- Prefer **plasma glucose (PG)** from lab when confirming or diagnosing **persistent** hypoglycaemia.
- **Whole blood** values are about **10–15% lower** than PG; processing delays **lower readings** by ~**6 mg/dL per hour** due to glycolysis. Start treatment based on bedside value in sick infants, but **send a sample**.

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## 6) Management algorithm

### A) First 24 hours (transitional period)

**Asymptomatic, at-risk infant**

1. **If PG <25 mg/dL (0–4 h)** or **<35 mg/dL (4–24 h) → feed immediately** (prefer **mother’s milk/expressed breast milk**) **plus 40% dextrose gel 0.5 mL/kg** rubbed into buccal mucosa; re-check in 30–60 min. Repeat gel up to **3 doses per episode** as per local protocol.
2. If still below the action threshold or **PG <45 mg/dL** despite feeds/gel → **start IV dextrose** (see below).

**Symptomatic** (any time) **or very low PG**

- **Immediate IV therapy: D10W bolus 2 mL/kg (200 mg/kg)**, then infusion targeting **GIR 4–6 mg/kg/min** (≈ **D10W at 60–80 mL/kg/day**), titrating up (max typically **12 mg/kg/min**) to maintain target PG. Continue breastfeeding if stable.

**Escalation**

- If repeated boluses or **GIR >8–10 mg/kg/min** are required to keep PG in range, **suspect hyperinsulinism/persistent disorder**—draw **critical sample** (below) and involve neonatology/endocrinology.

### B) Beyond 48 hours (persistent hypoglycaemia window)

- **Targets**: maintain **>60 mg/dL** (PES); if a disorder is confirmed/suspected, **>70 mg/dL**.
- **Critical sample** (before giving IV bolus, if safe): PG, **insulin**, **β-hydroxybutyrate**, **free fatty acids**, **cortisol**, **GH**, **lactate**, **ammonia**, **acyl-carnitine profile** ± **urine ketones/organic acids**.
- **Likely causes**: **congenital hyperinsulinism**, hypopituitarism/GH deficiency, **cortisol deficiency**, **fatty-acid oxidation** or **gluconeogenic** defects, severe sepsis. Manage with **glucose infusion**, **glucagon** (temporary), **hydrocortisone**, **diazoxide/octreotide** as per specialist advice.

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## 7) Oral 40% dextrose gel

- **Dose: 0.5 mL/kg (200 mg/kg)** buccally, followed immediately by a feed; may repeat (commonly up to **3 doses** per episode; institute maximum per local guideline).
- **Benefits:** improves correction, **reduces mother–infant separation and NICU transfer**, supports **exclusive breastfeeding**; safe in late-preterm/term infants in first 48 h. Evidence base: **Sugar Babies RCT**, Cochrane 2022, subsequent studies.

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## 8) IV dextrose

- **Bolus: D10W 2 mL/kg** (avoid higher concentrations peripherally).
- **Infusion:** start **D10W** to deliver **GIR 4–6 mg/kg/min**, titrate by **2 mg/kg/min** steps based on hourly PG; if **>8–10 mg/kg/min** needed or recurrent lows, **seek senior help** and evaluate for persistent causes. Central line if higher concentrations required.

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## 9) Documentation, monitoring & discharge

- **Chart**: risk category, times of feeds, gel doses, glucose values (with **sample type**—whole blood vs plasma), treatments, clinical signs.
- **Stop-criteria / discharge** (typical): maintaining **pre-feed PG ≥45 mg/dL** in first 24 h (or **≥60 mg/dL after 48 h**), **2–3 consecutive feeds without rescue**, feeding well, afebrile, and no intercurrent illness; arrange follow-up if at risk.

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## 10) Bedside differential & red flags

- **Sepsis, hypothermia, respiratory distress**—can both **cause** and **mask** hypoglycaemia; treat concurrently.
- **Polycythaemia**, **perinatal asphyxia**, **drug exposure (β-blockers)**.
- **Persistent need for high GIR**, **seizures**, **recurrent symptomatic lows → urgent endocrine/metabolic work-up**.

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## 11) Quick revision tables

### 11.1 Operational thresholds & actions (late-preterm/term)

| Hours of age | Action threshold (AAP) | Action |
|---|---|---|
| 0–4 h | **<25–40 mg/dL** | Feed **+ 40% gel** (asymptomatic); IV D10W if symptomatic or very low |
| 4–24 h | **<35–45 mg/dL** | Feed **+ 40% gel**, recheck 30–60 min; IV if persisting/low |
| ≥24 h | **Aim ≥45 mg/dL** | Optimise feeds; IV if unable to maintain target |
| >48 h (PES) | **Maintain >60 mg/dL**; **>70 mg/dL** if disorder suspected | Evaluate **persistent** hypoglycaemia; specialist input |

### 11.2 Symptoms snapshot

| Subtle | Severe |
|---|---|
| Jitteriness, poor feeding, lethargy, hypotonia, hypothermia | Apnoea, cyanosis, seizures, coma |





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### 11.3 Testing pearls

- **Plasma** > **whole blood** by ~**10–15%**; confirm persistent cases with **lab PG**; minimise processing delay.

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## 12) Kaumārabhṛtya alignment (conceptual, exam-style prose)

- **Bāla-rakṣaṇa** emphasises **early, adequate stanya** (human milk) and warmth—these reduce transitional hypoglycaemia by ensuring substrate supply and reducing energy drain (crying, cold stress).
- Avoid unnecessary separation; continue breastfeeding even during IV therapy where safe—modern evidence shows dextrose gel **supports** exclusive breastfeeding.

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## Self-assessment

### MCQs (one best answer)

1. A 2-hour-old, asymptomatic LGA baby has PG **32 mg/dL**. Best next step:
   A. Observe only B. Start IV D25W bolus C. **Breastfeed immediately + 40% dextrose gel 0.5 mL/kg; recheck in 30–60 min** D. Keep NPO and recheck in 6 h
   **Answer:** C.
2. Which pairing is **correct** according to PES?
   A. After 48 h, target ≥45 mg/dL
   B. **After 48 h, maintain >60 mg/dL; >70 mg/dL if a disorder suspected**
   C. First 48 h, maintain >70 mg/dL
   D. Oral gel contraindicated after 12 h
   **Answer:** B.
3. Which statement about glucose measurement is **true**?
   A. Whole blood = plasma
   B. **Plasma is ~10–15% higher than whole blood; confirm persistent lows with lab PG**
   C. Processing delay raises the glucose value
   D. Strip value is always accurate
   **Answer:** B.
4. Need for **GIR >10 mg/kg/min** to keep PG normal suggests:
   A. Physiological transitional fall
   B. **Hyperinsulinism/persistent disorder**
   C. Meter error only
   D. Feeding intolerance
   **Answer:** B.
5. 40% dextrose gel in late-preterm/term infants primarily:
   A. Increases NICU admissions
   B. **Reduces separation and supports exclusive breastfeeding**
   C. Causes rebound hypoglycaemia
   D. Is ineffective compared to feeds alone
   **Answer:** B.

### Short-answer prompts (3–5 lines)

- Define **operational thresholds** in the first 24 h and list two risk factors.
- Outline the **dextrose gel** protocol and when to escalate to IV.
- List the components of a **critical sample** for persistent hypoglycaemia.
- Write discharge criteria after a hypoglycaemia episode.

## References

### Classical (conceptual alignment)

- **Caraka Saṃhitā**, Sūtrasthāna 27 (*Annapanavidhi Adhyāya*): food regimens and nourishment logic supporting early appropriate feeding.
- **Kāśyapa Saṃhitā (Vṛddhajīvakīya Tantra)**: primacy of **stanya** (breast-milk) for infant growth; text resources and overviews.
  *(No neonatal-specific hypoglycaemia verse is quoted to avoid inaccuracy.)*

### Modern guidelines & key reviews

- **AAP Clinical Report (2011)**: *Postnatal glucose homeostasis*—time-sensitive thresholds and algorithms.
- **Giouleka S, 2023** (open-access narrative review): operational thresholds summary (25–40; 35–45; ≥45 mg/dL).
- **PES Recommendations (2015)**: targets and evaluation of **persistent** hypoglycaemia; maintain **>60 mg/dL after 48 h**, **>70 mg/dL** if a disorder is suspected.
- **StatPearls 2023**: risk factors, symptoms, IV management overview.
- **Endotext 2023**: persistent hypoglycaemia work-up; “critical sample” components.
- **ABM Protocol #1 / Breastfeeding Medicine**: **whole-blood vs plasma** difference (10–15%) and transitional physiology.
- **Cochrane Review 2022; “Sugar Babies” RCT 2013**: efficacy/safety of **40% dextrose gel 0.5 mL/kg**.
- **Hospital/Pathway exemplars** (for local adaptation): CHOP pathway; Starship 40% gel dosing page.

### 60-second recap

Screen **at-risk** babies early. Use **operational thresholds** (AAP: <25–40 mg/dL at 0–4 h; <35–45 at 4–24 h; aim ≥45 by 24 h). Treat **asymptomatic** lows with **breast-milk + 40% dextrose gel (0.5 mL/kg)**; **symptomatic/very low → IV D10 bolus + infusion**. After **48 h**, maintain **>60 mg/dL** (PES), investigate **persistent** cases with a **critical sample**, and consider **hyperinsulinism** if high GIR needed. Confirm values in **plasma**, remembering **whole blood ≈10–15% lower**. Keep mother and baby together, prioritising **breastfeeding** while you stabilise glucose.