Newborn Hypoglycemia

Self – Learning Module

Developed by the Interprofessional Education and Research Committee of the Champlain Maternal Newborn Regional Program (CMNRNP)

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Disclaimer: This self-learning module is intended for health care providers caring for term, low-risk newborns. Please refer to institutional policies and procedures.
Newborn Hypoglycemia: A Self Learning Module

Definition

Hypoglycemia is the most common metabolic problem seen in the neonate. The term hypoglycemia refers to a low blood glucose concentration. The definition and management of hypoglycemia remain controversial and recommendations vary as to which glucose values require treatment (Canadian Paediatric Society (CPS), 2013; Milcic & Nash, 2008). No uniform standard exists.

Hypoglycemia cannot be described by a single value because it may be different between neonates due to their physiologic immaturity and their current pathophysiology (Cornblath & Ichord, 2000). Every institution should have clearly developed policies regarding neonatal glycemic levels and therapeutic goals that direct their interventions. At present, a plasma glucose concentration of less than 2.6 mmol/L appears to be abnormal for term and preterm newborns and requires intervention (CPS, 2013).

1. Physiology

In utero, the fetus depends on the maternal supply of glucose. After birth, the neonate’s glucose supply is disrupted and endogenous glucose metabolism begins. This mobilization of fuel sources is a complex balance between glucose utilization, glucose production and hormonal responses (Milcic & Nash, 2008). Mechanisms for glucose production and utilization include glycogenesis, glycogenolysis, glyconeogenesis, lipolysis, and ketogenesis. Glucose is the predominant fuel for the newborn brain. There is risk of long term neurological damage with prolonged hypoglycemia (CPS, 2013).

Hormones play a vital role in the metabolism of glucose. Insulin is the major blood glucose-lowering hormone. Glucagon, epinephrine and cortisol are the hormones that raise the blood glucose level. The release of these hormones is regulated by the pancreas, adrenal glands and brain (Milcic & Nash, 2008).
Breastfed, formula-fed, and combination-fed newborns follow the same pattern of glucose values with an initial fall in glucose over the first 2 hours of life. Newborn blood glucose levels will gradually rise over the next 96 hours, whether fed or not. Breastfed newborns tend to have slightly lower glucose and higher ketone bodies than formula-fed newborns (Academy of Breastfeeding Medicine, 2006).

2. Causes and risk factors

Several classification systems have been used to define the causes of hypoglycemia. Two basic groups have been identified: (1) conditions associated with diminished hepatic glucose production, or transient hypoglycemia, and (2) conditions associated with excessive insulin production, or recurrent hypoglycemia. Table 1 outlines risk factors that suggest the need for screening.

Table 1: Risk factors of newborn hypoglycemia

<table>
<thead>
<tr>
<th>Maternal metabolic alterations</th>
<th>Diabetes (pregestational and gestational)</th>
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<tbody>
<tr>
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<td>Drug therapy (B-Blockers, intrapartum glucose administration)</td>
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<td>Preeclampsia</td>
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<td>Neonatal intrinsic problems</td>
<td>Beta-sympathomimetic exposure</td>
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<td>Beckwith-Weidemann syndrome</td>
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<td>Hypothermia</td>
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<td>Infant of a diabetic mother (IDM)</td>
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<td>Intrauterine growth restriction (IUGR)</td>
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<td>Polycythemia</td>
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<td>Prematurity &lt; 37 weeks</td>
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<td>Respiratory distress syndrome (RDS)</td>
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<td>Rh incompatibility</td>
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<td>Sepsis</td>
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<td>Small for gestational age (SGA)</td>
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<td>Large for gestational age (LGA)</td>
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<td>Twin gestation</td>
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<td>Newborns on parenteral nutrition</td>
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<td>History of poor feeding</td>
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<td>Neonatal metabolic disorders</td>
<td>Fatty acid defects</td>
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<td>Galactosemia</td>
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<td>Glycogen storage disease</td>
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<td>Maple syrup urine disease</td>
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<td>Neonatal endocrine disorders</td>
<td>Congenital glucagon deficiency</td>
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<td>Cortisol deficiency</td>
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<td>Pituitary insufficiency</td>
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(ACoRN, 2012; CPS, 2013; Cowette & Loughead, 2002; Hawdon, 2008; Milcic & Nash, 2008)
2.1. Transient hypoglycemia

Diminished hepatic glucose production which may be related to:
- Reduced glycogen stores, decreased gluconeogenesis, and ketogenesis
- Hyperinsulinemia
- Metabolism of brown fat
- Depressed plasma glucose concentration

- **Maternal factors** including intrapartum administration of glucose, drug treatment (oral beta-sympathomimetic agents, propranolol) and diabetes (Cowette & Loughead, 2002; Milcic & Nash, 2008).

- **Neonatal factors** including idiopathic conditions or adaptation failure, intrauterine growth restriction (IUGR), small for gestational age (SGA), large for gestational age (LGA), prematurity, perinatal stress/asphyxia, hypoxia, cold stress, hyperviscosity, sepsis, congenital heart disease, and congestive heart failure (CPS, 2013; Cowette & Loughead, 2002; Milcic & Nash, 2008).

2.2. Recurrent hypoglycemia

- Secondary to hyperinsulinism or excessive insulin production which may be related to:
  - Islet cell hyperplasia
  - Enzymes disorders that cause disruption in several areas of carbohydrate metabolism
  - Endocrine disorders (pituitary insufficiency and cortisol, glucagon, and epinephrine deficiencies)
  - Umbilical catheter inserted at T11 to L1 (level of the vessels supplying the pancreas or the celiac axis)

- Associated conditions such as Beckwith-Wiedemann syndrome, Rh incompatibility, inborn errors of metabolism, nesidioblastosis, islet cell adenomas, adenomatosis, adrenal insufficiency, and iatrogenic causes such as beta-sympathomimetic exposure,
exchange transfusion, and a high placement of the umbilical artery catheter (Cowette & Loughead, 2002; Milcic & Nash, 2008).

3. Signs of Hypoglycemia

Signs of hypoglycemia are often subtle or may be absent altogether and are usually neurological in nature. Clinical signs of hypoglycemia are non-specific for any particular glucose concentration (Milcic & Nash, 2008). Signs of hypoglycemia are listed in Table 2.

Table 2- Signs of hypoglycemia

- Irritability, tremors or jitteriness
- Hypothermia, poor temperature control, sweating
- Poor feeding or intolerance of feedings
- Hypotonia, limpness or lethargy
- Tachypnea, grunting
- Abnormal cry (weak or high-pitched cry)
- Exaggerated Moro reflex
- Cyanosis, pallor
- Abnormal eye movements
- Apnea, irregular rapid breathing
- Seizures, coma
- Cardiac arrest or failure

Note: Often there is a cluster of these signs

Healthy term newborns with a normal perinatal course that are asymptomatic do not require monitoring of glucose levels (CPS, 2013; Deshpande & Ward Platt, 2005). Early feeding is important to prevent hypoglycemia.

4.1 Blood glucose monitoring

- Check serum glucose at 2 hours of age if the newborn is considered “at risk” for hypoglycaemia (refer to Table 1). Continue to monitor every 3-6 hours (before feeds) until glucose $\geq 2.6$ mmol/L as long as newborn remains well.
- Check serum glucose immediately if a newborn is symptomatic or unwell.

(ACoRN, 2012; CPS, 2013; Queensland Maternity and Neonatal Clinical Guidelines Program, 2013)

Please refer to the algorithms on the next pages for the screening and immediate management of babies at risk for neonatal hypoglycemia as per the Canadian Paediatric Society (CPS) and ACoRN. Institution specific policies or cut-offs may vary slightly. Close communication with interdisciplinary team members is necessary. Refer to institutional policies regarding when to notify the most responsible healthcare provider (e.g. physician, nurse practitioner, midwife).

Blood glucose concentrations show a cyclic response to an enteral feed, reaching a peak by about an hour after the feed, and the lowest blood glucose level (nadir) just before the next feed is due. Since the purpose of blood glucose monitoring is to identify the lowest blood glucose level, it is most logical to undertake such measurement immediately before a feed (pre-feed) rather than at arbitrary intervals at random intervals between feeds (Deshpande & Ward Platt, 2005).
Canadian Paediatric Society Screening Algorithm

**Algorithm for the Screening and Immediate Management of Babies at Risk for Neonatal Hypoglycemia**

**NEWBORN BABY**

Is the baby unwell?

**YES**

CHECK GLUCOSE NOW. INVESTIGATE FOR CAUSE AND TREAT ANY UNDERLYING CONDITION

< 2.6 mmol/l in an unwell baby. CONSIDER IV TREATMENT

< 2.6 mmol/l at 2 hours of age or < 2.0 mmol/l at subsequent checks. CONSIDER IV TREATMENT

1.8 - 2.0 mmol/l at 2 hours of age or 2.0 - 2.5 mmol/l at subsequent checks

Refeed and recheck glucose in 1 hour

Remains < 2.6 mmol/l despite feeding. CONSIDER IV TREATMENT

Rises to ≥ 1.6 mmol/l after feeding

INITIATE INTRAVENOUS INFUSION OF 10% DEXTROSE AT A RATE OF 80ml/kg/day (5.5mg glucose/kg/min). CHECK GLUCOSE 30 min AFTER ANY CHANGE AND ADJUST THERAPY (UP TO 100 ml/kg/day and/or 12.5% DEXTROSE) IN ORDER TO MAINTAIN GLUCOSE LEVEL ≥ 2.6mmol/l. IF RATES IN EXCESS OF 100 ml/kg/day OR 12.5% DEXTROSE ARE REQUIRED INVESTIGATION, CONSULTATION AND/OR PHARMACOLOGICAL INTERVENTION ARE INDICATED. MAY START WEANING IV 12 HOURS AFTER STABLE BLOOD GLUCOSE IS ESTABLISHED. CONTINUED BREASTFEEDING IS ENCOURAGED.

**NO**

ROUTINE CARE: INITIAL FEED

Is the baby at risk? SGA, LGA, IDM or preterm

**NO**

ROUTINE CARE: FEED ON DEMAND AS LONG AS INFANT REMAINS WELL

WHEN TO STOP TESTING: IDM AND LGA DO NOT REQUIRE RETESTING IF SUGAR > 2.6 mmol/l AFTER 12 HOURS OF AGE AS THEY USUALLY PRESENT BY THIS TIME. PRETERM AND SGA INFANTS DO NOT REQUIRE RETESTING AFTER 36 HOURS PROVIDE STABLE LEVELS AND INTAKE ARE ACHIEVED

ACoRN Sequence for Hypoglycemia Screening and Management

**The Fluid & Glucose Management Sequence**

- **Fluid & Glucose Management**
  - Blood glucose < 2.6 mmol/L
  - At risk for hypoglycemia
  - Not feeding or should not be fed

- **Problem List**

- **Fluid & Glucose Management Sequence**
  - **Cannot feed**
    - Continue IV D10%W at 4 mL/kg/hr
    - Check glucose in 30 minutes
    - Consultation
    - Focused history and physical examination
    - Calculate fluid requirements
  - **Can feed**
    - Glucose < 1.9
    - Glucose 1.8 to 2.5
    - Glucose ≥ 2.6
      - Feed measured volumes
      - 8 mL/kg q 2 hours
      - Check glucose after 1 hour
    - Feed ad lib
    - Check glucose prior to next feed
    - D10%W infusion at 3 mL/kg/hr
    - Check glucose in 30 minutes
    - Tolerating feeds

- **Hypoglycemic < 2.6**
  - Continue the "suggested steps for increasing intake if glucose checks remain < 2.6."
  - Check glucose 30 minutes after IV change, or 1 hour after feed and preprandial, until ≥ 2.6.
  - Consider consult
  - Persistent hypoglycemia
  - Consider central venous access if administering > D10%W
  - Rule out endocrine or metabolic disease
  - Obtain consult

- **Not hypoglycemic ≥ 2.6**
  - Monitor glucose q4 to 8h if on IV, or pre-feed until off IV, then until two consecutive samples are ≥ 2.6.

**ACoRN Editorial Board, (2012), p. 7-7.**

All glucose levels in the Sequence are in mmol/L. Blood glucose conversions: 1.8 mmol/L is equivalent to 32 mg/dL. 2.6 mmol/L is equivalent to 47 mg/dL.
4.2 Treatment strategies

Some strategies can be beneficial in preventing hypoglycemia. One such example would be skin-to-skin contact. Skin-to-skin contact may prevent decreased glucose levels through the promotion of thermoregulation and the establishment of breastfeeding (Provincial Council for Maternal and Child Health, 2012). However, when faced with an at-risk or symptomatic newborn, treatment strategies for hypoglycemia aim to normalize blood glucose levels. These strategies include enteral feedings, especially more frequent breastfeeding, intravenous (IV) glucose infusion, and pharmacotherapy. The baby’s condition will help determine which of these strategies are most appropriate (see page 8 and 9 for CPS and ACoRN algorithms).

4.2.1 Enteral feedings

If breastfeeding, manual expression of breast milk and spoon feeding can ensure milk transfer as colostrum is thick and may be difficult for the newborn to extract. Many times, the initiation of early enteral feedings to asymptomatic newborns can prevent or treat hypoglycemia. Note: Parental consent may be required if breast milk substitutes are needed. Refer to institutional policies and procedures.

4.2.2 Intravenous Therapy

Intravenous therapy is indicated when glucose levels remain persistently low despite adequate enteral feeding, if the newborn is too ill to eat, or becomes symptomatic. Glucose infusion rates should be titrated to maintain a blood glucose concentration of ≥ 2.6 mmol/L. As feedings are introduced, the IV glucose infusion should be decreased slowly to avoid fluctuation in glucose delivery (Deshpande & Ward Platt, 2005).

4.2.3 Pharmacotherapy

In some cases, newborns may require agents other than IV glucose infusions to treat their hypoglycemia for example, corticosteroids, or glucagon (Queensland Maternity and Neonatal Clinical Guidelines Program, 2013).
5. References


Canadian Paediatric Society (CPS) - www.cps.ca

Champlain Maternal Newborn Regional Program (CMNRP) – www.cmnrp.ca


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- Managers, educators, registered nurses, and registered practical nurses from partner organizations
- Maternal-Newborn Nursing Professors (College and University)