PEDIATRIC NEWBORN MEDICINE CLINICAL PRACTICE GUIDELINES

Neonatal Glucose Assessment and Clinical Management (May 2020)

Clinical Practice Guideline: Neonatal Glucose Assessment and Clinical Management

Points of emphasis/Primary changes in practice:

1. All "at risk" infants should be fed within one hour of life, by breast or bottle, per parental preference, and on an ongoing basis as determined by the care team and family. Formula supplementation may be necessary in the setting of neonatal hypoglycemia not initially responsive to dextrose gel and breastfeeding.

2. We are implementing the use of a dextrose gel that has been used for neonatal hypoglycemia and found to be safe and effective (RR 0.57, 95% CI 0.33-0.98) in reducing need for IV glucose in a large New Zealand cohort of 35-42 week infants "at risk" for hypoglycemia (Harris *et al*, Lancet, 2013). The goal of this practice change is to encourage exclusive breastfeeding (for families who choose this) and to minimize separation between mother and infant. Dextrose gel may be administered a maximum of three times during an infant's hospital stay.

3. Until the protocol specifies "Initiate transfer to the NICU", assessment and treatment should occur in the mother's room to minimize separation between mother and infant.

4. There are distinct pathways based upon hour of life, 0 – 4 hrs, > 4 - ≤ 24hrs, > 24hrs - ≤ 48 hrs, and > 48 hrs.

Rationale for change:
The goal of the guideline development committee was to incorporate new national consensus guidelines (American Academy of Pediatrics, 2011 and Pediatric Endocrine Society, 2014) and the experience at our institution to create revised guidelines that address two major changes/issues: 1) Providing distinct guidelines—specific to a newborn's hour of life. 2) Minimizing separation between mother and infant and supporting breastfeeding.

Clinical Guideline Name	Neonatal Glucose Testing and Clinical Management
CWN Clinical Practice Manual Policy Number	WNH G.1
Implementation Date	November 10, 2015, revised: December, 2016, revised: November, 2017, revised: April 2019 implementation
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Contact Person	Rimi Sen, MD
Approved By	Department of Pediatric Newborn Medicine Clinical Practice Council March 2019 CWN PPG BWH SPP Steering Nurse Executive Board/CNO

This is a clinical practice guideline. While the guideline is useful in approaching the care of the neonate at risk for hypoglycemia, clinical judgment and / or new evidence may favor an alternative plan of care, the rationale for which should be documented in the medical record.

I. Purpose

The purpose of this clinical practice guideline is to incorporate new national consensus guidelines (AAP, 2011 and Pediatric Endocrine Society, 2014) and the experience of our institution to create revised guidelines that address two major changes/issues:

1) Providing distinct guidelines—based on hour of age.
2) Minimizing separation between mother and infant and supporting breastfeeding.

This clinical practice guideline is primarily relative to the clinical management of hypoglycemia. Significant hyperglycemia is defined as blood glucose > 120. For infants in the Center for Labor and Birth with a blood glucose >120, call NICU triage for a consult and in Well Baby Nursery call the private pediatrician.

II. All CPGs reflect the NICU Nursing Standards of Care. All relevant nursing PPGs are listed below.

WNH A.1 Alternative Feeding Methods for Breastfeeding Infants (check all hyperlinks)
WNH B.2 Infant Heelstick Blood Sampling
WNH B.9 Infant Feeding
WNH H.6 Human Milk Administration
WNH I.6 Care of the Late Preterm Infant and Infants less than 2500 gms
WNH R.4 Newborn Rapid Response Situations and Infant Codes
WNH Standard Policy Statements
WNH T.1 Infant Thermoregulation

III. Prevention of Hypoglycemia

- Initiate parent education regarding prevention, evaluation and treatment of hypoglycemia.
- Optimize thermoregulation: dry hat at all times for infants who are at risk or being managed for hypoglycemia, avoid wet clothing, use warm blankets when wrapped, ambient temperature set to $\geq 72^{\circ}F$.
- Initial bath should be held until monitoring for hypoglycemia has been initiated and ideally, completed.
- Encourage skin to skin care for all infants, particularly those at risk for hypoglycemia.
- Axillary temperature should be measured at the time of all BG measurements.
- "Skin to skin/incubator care" refers to baby being either skin to skin or in an incubator at all times when not feeding.
- All SGA infants (<10% for gestational age) and preterm (<37 weeks) should be considered for exclusive skin to skin/ incubator care (radiant warmer instead of incubator on CWN 5) until thermoregulation, euglycemia, and adequate po feeding is achieved.

III. Transitional Hypoglycemia

Definitions:

- The definition of "low plasma glucose" is variable depending upon the hour of age of the newborn. Please refer to Green, Yellow, or Red pathways for specific numbers.
- Literature suggests that in the first several hours of life, infant's transition from a lower *in utero* set point to a higher lifelong set point. It is expected that infants' blood sugars steadily rise over the first 48 hours of age. It should be noted that infants in the first 48 hours of life have a state of "regulated hyperinsulism" resulting in suppression of ketone production. This leads to newborn infants being at particularly high risk for hypoglycemic neurologic injury (Thornton *et al*, J Peds, 2015.)

Who should be tested?

1. Symptomatic infants: Irritability, tremors, jitteriness, lethargy, hypothermic
    a. These infants require one BG test. If normal (as determined by hour of age) x1, no further BG testing required.
    b. If abnormal, follow Yellow or Red Pathway.
    c. If a blood sugar is being checked because the infant is symptomatic, the infant falls into risk category 2 (higher risk) <u>if the DS is abnormal</u>. Thus, the baby should be screened for a longer period of time (which pathway -- red or yellow -- depends upon the degree of hypoglycemia).
    d. If the baby is symptomatic and the blood sugar is normal x 1, no further blood sugar checks are indicated as the symptoms are likely not due to hypoglycemia.
2. <u>Infants less than 48 hours old who fall into any of these categories should have a BG tested within one hour of birth and evaluation by MD as needed:</u>

Risk Category 1	**Risk Category 2**

Infants of diabetic mothers (IDM) (any class or treatment) LGA based on weight for gestational age >90% Post-dates >$42^{0/7}$ weeks 5 min Apgar <7 Respiratory distress >1hr Maternal treatment with beta blockers (propranolol) for any length of treatment or terbutaline for > 48hrs	SGA (10%, see below) Preterm (<$37^{0/7}$ weeks) Birth weight <2500gm Family history of hypoglycemia, midline abnormalities (e.g. midline facial abnormalities or microphallus) or congenital syndrome associated with hypoglycemia (e.g. Beckwith Wiedemann)

If BG is in the red pathway or infant is transferred from the yellow to the red pathway: :

- Initiate transfer to NICU (discuss with attending pediatrician during the day and page DR-1 overnight)
- Upon admission to NICU triage, repeat POC BG and obtain STAT plasma glucose (PG). The results of these BG measures determine the plan of care for the infant, as follows:
- If BG is in the ***redder*** category: Provide D10W bolus (2ml/kg) and start IVF at gestational age appropriate rate via PIV (60ml/kg/day). If infant appears to have environmental contributions to hypoglycemia (e.g. is hypothermic), MD in triage may consider providing D10 bolus, recheck BG in 30 minutes, and then starting IV dextrose if BG remains low despite bolus and resolution of environmental factors.
- If BG is in the ***red*** category: If infant has previously received dextrose gel less than 3 times , provide dextrose gel and feeding (breast or bottle per algorithm). If 3 gels have already been given, place PIV and begin D10W at 60ml/kg/day via PIV
- If BG is in the ***yellow*** category: If infant has previously received dextrose gel less than 3 times, provide dextrose gel and feeding (breast or bottle per algorithm A). If 3 gels have already been given, place PIV and start D10W at 30 ml/kg/day. .
- If BG is in the ***green*** category: Restart Green Pathway in NICU triage or newborn nursery, per decision of attending pediatrician in consultation with parents, medical and nursing staff. The next POC BG or PG should be done in NICU triage.
- Recheck BG 30 min after interventions
- Adjust Glucose Infusion Rate (GIR) to goal BG>45
- Consider weaning GIR by 0.5 if BG >50 and by 1 if BG>60

$$\text{GIR (mg/kg/min)} = \frac{\text{\% glucose * IV rate (mL/hr)}}{\text{6* body weight (kg)}}$$

Please see link to the "Table to quickly calculate glucose infusion rates (GIR) in neonates" for further assistance.

If BG is in the yellow pathway:

- RN administers Dextrose Gel, 40%, 0.5ml/kg, massaged into buccal mucosa (gel is available in unit Omnicell as override medication)
- 30 minutes after administration, blood glucose (BG) should be rechecked.
    - If BG is still in the "yellow", dextrose gel can be administered two more times and BG rechecked 30 min after gel and feeding complete. MD should be notified if BG moves to the "red" pathway (on CWN 5 MD is DR1, on CWN 9 & 10, MD is covering pediatrician.) Per algorithm, formula supplementation should be provided with the second and third gel. An important point of emphasis to families is that formula supplementation in this setting is being used as a treatment to avoid ongoing hypoglycemia rather than as a method of feeding. For this reason, it should also be stated that formula is preferable to pasteurized human donor milk (PDHM) because of its higher and more consistent glucose content compared to PHDM. When formula supplementation is needed, mothers should be encouraged to pump in order to stimulate lactogenesis.
        - NOTE: Dextrose gel cannot be given more than three times during the hospital stay
    - If BG is still low after three gel administrations, initiate transfer to NICU and notify MD.

If BG is in the green pathway, infant can receive standard care:

- Infants who are in risk category 1: Infants born to all classes of diabetic mothers or mothers receiving beta blockers, large for gestational age, post dates (>$42^{0/7}$ weeks), low 5 min Apgar <7, or respiratory distress >1hr should have a total of three q3h (at approximately 1, 4 and 7 hours of life) BG checks. BG should be ≥40 mg/dL in first 4 hours of life, then ≥45 mg/dL between 4-24 hours of life.
- Infants who are in risk category 2: small for gestational age, preterm (<$37^{0/7}$ weeks), have a family history of hypoglycemia, have midline defects or were symptomatic require more prolonged monitoring for hypoglycemia. These infants will have three q3h BG checks, followed by two q6h (at approximately 1, 4, 7, 13 and 19 hours of life) BG checks. BG should be ≥40 mg/dL in first 4 hours of life, ≥45 mg/dL between 4 and 24 hours of life ***One of these checks should be pre-feed.***
- For infants at the highest risk for an underlying endocrinopathy or metabolic disorder (those with a family history of hypoglycemia, midline defect or syndrome associated with hypoglycemia or previously symptomatic), a safety fast should be considered in consultation with endocrine.
- A safety fast should be ordered by the attending pediatrician (if infant is in the well-baby nursery) or neonatologist (if infant is in the NICU.)
- Unless infant requires transfer to NICU or NICU triage per algorithm, all testing and treatment can be performed in mother's room. The goal of this practice change is to minimize separation between mother and infant.

IV. Persistent Hypoglycemia (Infants 48 hours of life or older)

Definitions:

- Plasma glucose less than 60mg/dL should be considered hypoglycemia in infants over 48 hours of age. Around this time, infants should be approaching their lifelong glycemic set point (Thornton *et al*, J Peds, 2015.)

If BG is in the red pathway or infant is symptomatic:

- Initiate transfer to NICU
- If infant has never received dextrose gel, provide dextrose gel and feed (breast or bottle per parental preference)
- If BG is in the ***redder*** category, provide D10W bolus (2ml/kg) and start at gestational age appropriate rate via PIV (60-80ml/kg/day)
- If BG is in the ***red*** category, begin D10W at gestational age appropriate rate via PIV (60-80ml/kg/day)
- If BG is in ***yellow*** category, and infant can receive dextrose gel, do not start PIV unless BG rechecked 30 min after gel administration is still <60mg/dL
- If infant cannot receive additional gel for this BG, and has a BG in ***yellow*** category, start PIV with D10W at gestational age appropriate rate.
- Recheck BG 30 min after intervention
- Adjust Glucose Infusion Rate (GIR) to goal BG≥60mg/dL
- Consider weaning GIR by 0.5 if BG ≥65 mg/dL and by 1 if BG≥75mg/dL

If BG in the yellow pathway:

- Provide dextrose gel ASAP once
- Allow infant to breast or bottle feed (per parental preference) po ad lib, at discretion of team
- Notify MD (MD is covering pediatrician during the day and DR-1 over night)
- Recheck BG 30 min after glucose gel
- If subsequent BG is ≤59, proceed to RED pathway
- If subsequent BG is ≥60, restart GREEN pathway

If BG is >60mg/dL (normal – green pathway):

- Continue breast or formula feeding po ad lib
- If *off* IV glucose, can stop BG check if BG≥60mg/dL x 3 before feeding (approximately q3h)
- If *on* IV glucose, (TPN or IVF) BG should be checked AT LEAST BID or with IVF rate changes while on IV glucose.

Notes and Special Considerations for persistent hypoglycemia:

- In cases of prolonged hypoglycemia, infants who are exclusively breastfed may require supplementation or bottle-feeding of pumped milk to better understand the contribution of maternal milk production in etiology of hypoglycemia.
- Consider endocrine consultation and check newborn screening result (can call state lab for a quicker turn-around time if high suspicion) around 4-5 days of life if:

- GIR is high (>8) or increasing
- Infant is requiring caloric fortification to maintain normal BG. These infants may be trialed off caloric fortification before discharge. If BG normal (q3h ac BG ≥60mg/dLx3 and then q6h ac BG≥60mg/dLx3) on 20 kcal/oz then endocrine consultation or safety fast (below) may not be necessary.
- Infant has a family history of hypoglycemia or is syndromic

- Consider six hour safety fast before discharge for infants at highest risk for an underlying metabolic disorder or endocrinopathy. These are infants who:
  - Discharged home on caloric fortification due to hypoglycemia
  - Required IV glucose after day of life 4 for hypoglycemia
  - Family history of hypoglycemia, syndromic or has midline defects

  A safety fast should be ordered by the attending pediatrician (if infant is in the well-baby nursery) or neonatology team (if infant is in the NICU.)

Safety Fast:

- A safety fast is different than a diagnostic fast.
  - A safety fast is a way to unmask an underlying endocrinopathy or metabolic disorder in a high-risk infant (see risks above).
  - It involves allowing a high-risk infant to go 6 hours without feeding and checking serial blood glucose measurements.
  - If a safety fast is failed, then an endocrinologist should be consulted and a diagnostic fast (aka glucagon stimulation test) considered.
- All safety fasts should be performed after 48 hours of age.
- Please see Appendix: Instructions for Safety Fast, for more detailed information and instructions regarding the safety fast for infants in the well baby nursery and NICU.

IIV. References

1. Committee on Fetus and Newborn, Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. Pediatrics 2011;127:575-9.

2. Thornton PS, Stanley CA, De Leon DD, Harris D, Haymond MW, Hussain K, Levitsky LL, Murad MH, Rozance PJ, Simmons RA, et al. Recommendations from the Pediatric Endocrine Society for Evaluation and Management of Persistent Hypoglycemia in Neonates, Infants, and Children. J Pediatr 2015;

3. Stanley CA, Rozance PJ, Thornton PS, De Leon DD, Harris D, Haymond MW, Hussain K, Levitsky LL, Murad MH, Simmons RA, et al. Re-evaluating "transitional neonatal hypoglycemia": mechanism and implications for management. J Pediatr 2015;166:1520,1525.e1.

4. 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;382:2077-83.

5. Chowing R, Adamkin DH. Table to quickly calculate glucose infusion rates in neonates. J Perinatol 2015;35(7): 463. doi: 10.1038/jp.2015.42. Epub 2015 Apr 23.