Managing Neonatal Hypoglycemia: Can formula supplementation be avoided?

Shawnte’ R. James, MD, FAAP
Assistant Professor
Newborn Medicine Hospitalist
Emory University School of Medicine
Department of Pediatrics
Division of Neonatal-Perinatal Medicine

Faculty Financial Disclosures

• In accordance with the ACCME standards for commercial support, all faculty members are required to disclose to the program audience any real or apparent conflict(s) of interest to the content of their presentation.
• I have nothing to disclose.

Case 1

Baby Carlton is an early term newborn (38.0 weeks) who was delivered by STAT C/S after loss of fetal heart tones. His APGARs were 6/9/9, he is AGA. He arrives in the holding nursery at 45 minutes of life, and his initial glucose is 44. Because of the STAT C/S, his mother was under general anesthesia for the delivery. What is the most appropriate next step in the management of Baby Carlton?

A. No supplementation, await mother’s availability for S2S and breastfeeding
B. No supplementation and immediately have L+D nurse hand express mother’s colostrum to feed to baby
C. No supplementation and recheck sugar in 1 hour
D. Supplement with 5-10mL of formula via cup or syringe
E. Supplement with bottle/nipple to feed to satisfaction
How do we define hypoglycemia?
Case 1
(If you’re curious, here’s what I would choose)

Baby Carlton is an early term newborn (38.0 weeks) who was delivered by STAT C/S after loss of fetal heart tones. His APGARS were 6/9/9; he is AGA. He arrives in the holding nursery at 30 minutes of life, and his initial glucose is 44. Because of the STAT C/S, his mother was under general anesthesia for the delivery. What is the most appropriate next step in the management of Baby Carlton?

A. No supplementation, await mother’s availability for S2S and breastfeeding
B. No supplementation and immediately have L+D nurse hand express mother’s colostrum to feed to baby
C. No supplementation and recheck sugar in 1 hour
D. Supplement with 5-10mL of formula via cup or syringe
E. Supplement with bottle/nipple to feed to satisfaction

Endocrinology

- Plasma glucose concentration low enough to cause signs of symptoms of impaired brain function.
- If unable to communicate symptoms, PG levels below the normal threshold for neurogenic responses
  - <60 mg/dL (<3.3 mmol/L)

Merck Manual of Diagnosis and Therapy

- Plasma glucose concentration < 40 mg/dL (< 2.2 mmol/L) in term neonates or < 30 mg/dL (< 1.7 mmol/L) in preterm neonates
American Academy of Pediatrics

Screening and Management of Postnatal Care Issues in Late Preterm and Term SGA, OMHLGA Infants

American Academy of Breastfeeding Medicine

- A “reasonable (although arbitrary) goal” is to maintain plasma glucose concentrations between 40 and 50 mg/dL (between 2.2 and 2.8 mmol/L)
- “Acceptable and stable” value of >40 mg/dL (>2.2 mmol/L)

How do we define hypoglycemia?

TAKE HOME POINT:
The definition of neonatal hypoglycemia in the first 48hrs of life for term and late preterm newborns remains one of the most contested and controversial topics in Neonatal/Perinatal Medicine.
Alexis Hartmann, MD and Joseph Jaudon, MD (1937)

"...the frequent occurrence in normal newborn infants of cyanosis, irritability, listlessness and muscular disorders... might very well be due sometimes to hypoglycemia."

"... is almost a "normal" occurrence during the first few days of life."


Intrauterine Glucose

• Principal energy substrate for placenta and fetus
• Needs to be kept relatively constant to ensure steady growth of fetus
• Levels controlled by three mechanisms:
  • Maintenance of maternal glucose concentration
  • Transfer of maternal glucose to fetus through placenta
  • Production of insulin by the fetal pancreas
Fetal oxidation of intrauterine glucose

- Regulated by glucose transporters (GLUT4) in the insulin sensitive tissues (tissues with IR's)
  - Up or down-regulated in response to changes in fetal glucose concentration
  - RATE is dependent on the relative interaction between two components:
    - Fetal plasma glucose
    - Fetal insulin concentration

Regulation of glucose metabolism by insulin

Glucose in the healthy newborn

- Decreases by 25-35mg/dL in the first 2-3 hours of life
- Reaches a nadir at ~3hrs of life
- Steadily increases to reach normal levels in 24-48hrs
Clinical Hypoglycemia

- Serum glucose concentration low enough to cause symptoms and or signs of impaired brain function.

- Symptoms
  - Autonomic
    - Adrenergic
      - Palpitations, tremor, anxiety
    - Cholinergic
      - Sweating, hunger, paresthesia
  - Neuroglycopenic
    - "Brain fog"
    - Confusion
    - Coma

How does exclusive breastfeeding affect a newborn's glucose?

- Exclusively breastfed infants do not receive full caloric intake for several days after birth, resulting in hypoglycemia.
- Ketogenesis is partially activated, but measured ketones in neonatal serum in the first days of life are low (0.7 – 1.4mmol/L)

Are ketones an acceptable alternative fuel source for neonates in the first 24-48hrs of life?

- Without specific measurement of ketone levels during the period of hypoglycemia in question, it CANNOT be assumed ketones are available and sufficient to support brain metabolism.
- It CANNOT be assumed that ketones will protect brain metabolism in a breast-fed infant if post-natal fasting state/hypoglycemia is prolonged.
So what should we do?!

(I'm kidding, I actually know what we should do this time)
How to effectively increase glucose concentration in hypoglycemic neonate?

- Intravenous dextrose fluids
- PO feeds with EBM or formula

...and for bonus points?

ORAL DEXTROSE GEL!!! 😊
Implementing a Protocol Using Glucose Gel to Treat Neonatal Hypoglycemia. (Bennett, Fagan, et. al.)

Abstract

“Neonatal hypoglycemia is a leading cause of admission of neonates to the NICU. Typical treatment for neonatal hypoglycemia includes supplementation with formula or, in some cases, intravenous glucose administration. These treatments, though effective at treating hypoglycemia, interrupt exclusive breastfeeding and interfere with mother-infant bonding. Our institution developed a treatment algorithm for newborns at risk for neonatal hypoglycemia. The new algorithm called for the oral administration of 40% glucose gel. This intervention resulted in a 73% decrease in admission rates to the NICU for hypoglycemia, and it supported exclusive breastfeeding, skin-to-skin contact, and mother-infant bonding.”

http://nwhjournal.org/article/S1751-4851(15)00002-1/fulltext

“Basic steps in glucose gel algorithm”

• Neonates are placed skin to skin and breastfed within the first hour of life.
• A BG level is obtained 30 minutes after this feeding is completed.
• If the BG level is <35 mg/dl the nurse administers a weight-based dose of 40% glucose gel by syringe to the neonate’s buccal cavity and then places the neonate with the mother to feed.
• A BG level is then repeated 1 hour after gel administration.
• If this BG level is >35 mg/dl, the neonate’s BG levels are assessed before feedings until two consecutive readings are >45 mg/dl.
• If the neonate’s BG level is <35 mg/dl, a second dose of the gel is administered, and the neonate is again placed with the mother to feed.
• In the event that a second dose is needed, a BG level is obtained 1 hour after gel administration.
• If hypoglycemia is not reversed after the second dose of 40% glucose, the physician is contacted for further orders.
Results of Protocol Implementation

- Reduction of NICU admissions
  - Since implementation, 73% reduction in NICU admits with primary diagnosis of hypoglycemia.

- Effect on exclusive breastfeeding
  - During 14mo post-implementation, 494 out of 1,089 women with neonates at risk for hypoglycemia chose exclusive breastfeeding as first feeding choice
    - 49% were successful
Weight Dose (mL) Dose (g)
1.9-2.499 kg 1.0 mL 0.4 g
2.5-3.499 kg 1.5 mL 0.6 g
3.5-4.5 kg 2.0 mL 0.8 g
> 4.5 kg 2.5 mL 1.0 g

Breast Fed Babies
Skin to skin/breastfeed Initial glucose at one hour of age even if skin to skin

Formula Fed Babies
Skin to skin Initial glucose at one hour of age even if skin to skin
Initial Blood Glucose ≥ 45mg/dl
Ad lib feed at least every 3 hours and continue BG screen for 24 hours
Any BG < 25 (or too low to register) Administer 0.5ml/kg Dextrose gel AND feed formula immediately
Recheck BG one hour after initial glucose screen then notify MD/NNP results
Any BG result 25-44 mg/dl Breast fed babies Administer 0.5ml/kg dextrose gel and breast feed immediately as able *
Recheck BG one hour after initial glucose screen
Any BG result 25-44 mg/dl Formula Fed babies Feed formula ad lib immediately
Recheck BG one hour after initial glucose screen
Repeat BG <45mg/dl Administer 0.5ml/kg Dextrose gel AND ad lib feed formula immediately
Recheck BG 30 minutes after formula supplementation
If result <45 mg/dl notify MD/NNP
Repeat BG ≥ 45 mg/dl Ad lib feed at least every 3 hours and continue BG monitoring before feeds for 24 hours and at least 12 hours after any glucose <45
* Volume of supplemental feeding is not limited

EBM is the first choice Minimum volume is 10-15ml if available

Take Home Points
- The definition of hypoglycemia is strongly contested in Neonatology, so your institution should develop its own policy for diagnosis.
- Relying on baby’s fasting mechanisms to self-regulate serum glucose concentrations is NOT recommended.
- Managing neonatal hypoglycemia can be safely managed *without* large volume formula feeds, and often is well-managed using consistent supplementation with mother’s EBM and oral glucose gel
Baby Carlton is an early term newborn (38.0 weeks) who was delivered by STAT C/S after loss of fetal heart tones. His APGARS were 6/9/9, he is AGA. He arrives in the holding nursery at 45 minutes of life, and his initial glucose is 35. Because of the STAT C/S, his mother was under general anesthesia for the delivery and is not available to breastfeed. You decide to supplement Baby Carlton with formula to manage his hypoglycemia.

Which is the best option for formula supplementation for Baby Carlton?

a. 5-10mL via cup or syringe
b. 5-10mL via bottle
c. 10-20mL via syringe
d. 10-20mL via bottle
e. Bottle-feed to baby's satisfaction

Take Home Point

• Small amounts of formula supplementation (5-10mL) for neonates with hypoglycemia is AS EFFECTIVE as large volume feeds in normalization and stabilization of neonatal hypoglycemia.*

• Syringe/Cup/Spoon feeding is AS EFFECTIVE as bottle feeding to deliver this small volume supplement.*

*as caveat, this is preliminary data from EUHM Women's Services Late Preterm Hypoglycemia study.
Many Thanks and Much Love!

References


