

Hypoglycemia Management in NICU

1. Purpose:
 - a. To guide management of neonates admitted to the ANMC NICU with hypoglycemia.
 - b. To use an interdisciplinary approach in supporting neonates with hypoglycemia through initial treatment and stabilization of hypoglycemia and weaning of dextrose support.
 - c. This guideline is intended for the management of term or late preterm neonates who are mature enough and otherwise stable enough to eat.

2. Neonatal blood glucose level goals:
 - a. Distinguish between asymptomatic hypoglycemia and symptomatic hypoglycemia when considering how to approach treatment:
 - i. Asymptomatic hypoglycemic neonates (if otherwise appropriate) can trial interventions such as breast milk, glucose gel or formula before starting dextrose fluids
 - ii. Symptomatic hypoglycemic neonates require intervention with dextrose fluids
 - b. 0 to 4 hours of life: >35 mg/dL
 - c. 4 to 24 hours of life: >45 mg/dL
 - d. 24 to 48 hours of life: >50 mg/dL
 - e. >48 hours of life: >60 to 70 mg/dL

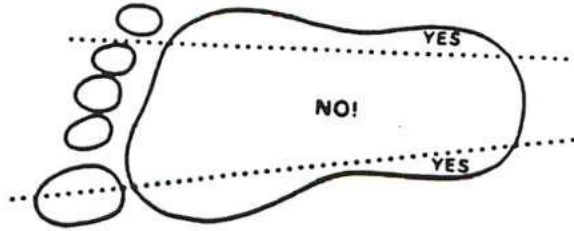
3. Initial NICU interventions:
 - a. Nursing care:
 - i. Prioritize IV access during the NICU admission process
 - ii. Check glucose level on admission to NICU
 - iii. Administer bolus if ordered
 - iv. Start D10W as ordered
 - v. Recheck glucose level 30 minutes after intervening on a low glucose level
 - vi. Consider placing infant in isolette to provide a neutral thermal environment (will maintain temperature while minimizing metabolic needs), be careful not to overheat
 - vii. Once glucose levels are above goal for age, continue Q3h glucose level checks (or preprandial checks, approximately Q3h)
 - viii. Once a neonate has three glucose levels at or above goal and is otherwise stable, consider Q6h glucose level checks until a fluids wean is initiated
 - ix. Encourage ad lib PO intake (if clinical condition allows)
 1. Offer feeds minimum Q3h
 2. Allow neonate to feed early or snack

3. If an infant eats more frequently than every three hours, do not need to check glucose levels more than every three hours (to conserve heel skin integrity)
 4. Continue to encourage breastfeeding, but prioritize maintaining appropriate glucose levels
 5. Can syringe feed if parent requests, but do not continue for more than one to two days as this does not promote a healthy suck response for normal breastfeeding or bottle feeding as milk volumes increase
- b. Physician care:
- i. Order glucose gel as needed until vascular access is achieved, give 0.5 mL/kg per buccal mucosa
 - ii. If glucose level on admission to NICU is below goal for age, consider sending a serum glucose level for confirmation
 - iii. If glucose level on admission to NICU is below goal for age, give D10W bolus, 2 mL/kg IV
 - iv. Start D10W at 80 to 100 mL/kg/day (5 to 8 mg/kg/min)
 - v. If infant requires two D10W boluses, consider changing fluids to D12.5W
 - vi. Consider continuous NG feeds (use breast milk or formula; do not use Pedialyte)
 - vii. If using formula, consider higher calorie formula as needed
 - viii. Discourage large increases in fluid volume (a general approach: if total fluid volumes are nearing more than 30 mL/kg/day above the typical daily rate, consider a central line)
 - ix. Using dextrose fluids with concentrations above D12.5W:
 1. Central access is required
 2. Fluids running at less than 10 mL/hr require the addition of heparin to the fluids at 0.5 units/mL
4. Stabilization and weaning supplemental dextrose support phase:
- a. Nursing care:
- i. Nurse/physician communication each shift regarding total fluids given that shift
 - ii. Give neonate initial bath (if not already done) after glucose levels have been stable for 12 hours
 1. Use radiant warmer to provide heat and maintain normal temperature
 2. Consider swaddle bathing to keep neonate calm and conserve energy
 3. Fully rewarm neonate to 98.6 F axillary under the radiant warmer before re-swaddling
 - iii. During weaning phase, hold wean and notify physician for glucose levels less than goal and provide interventions as ordered to raise glucose level

- iv. For term neonates who are eating well, IV fluids rate is driven by glucose levels, not by the standard NICU fluid protocol (i.e., do not increase IV fluids per the total fluids protocol if dextrose fluids are primarily being used to treat hypoglycemia)
 - v. When dextrose wean is complete, saline lock IV and continue preprandial glucose level checks (approximately Q3h, ok to coordinate with feedings) until there are three consecutive glucose level checks appropriate for age
 - vi. When glucose level checks are completed, remove vascular access if not needed for other clinical reasons
- b. Physician care:
- i. Nurse/physician communication each shift regarding total fluids given that shift
 - ii. While on fluids, check a BMP at 24 hours of life and every one to two days thereafter
 - iii. Initiate wean of dextrose fluids after glucose levels have been maintained above goal for at least 12 hours
 - iv. Typical IV fluids wean is by 1 mL/hr each time a preprandial glucose level is more than 60 mg/dL
 - v. If a neonate is on dextrose fluids concentrated above D12.5W, consider weaning by GIR, 1 mg/kg/min
 - vi. If a neonate is feeding more frequently than Q3h and has a reassuring pattern of preprandial glucose levels, consider liberalizing weaning plan to Q2-3h weans to correspond better with ad lib feeds
 - vii. Would not wean more frequently than Q2h
 - viii. Consider checking serum glucose levels in addition to point-of-care glucose levels after dextrose fluids are weaned to ensure glucose levels are truly normal for age (serum more accurate than POC, expect serum levels to be >70 mg/dL)
 - ix. Consider whether a safety fast is appropriate in neonates who have required on-going treatment for hypoglycemia for more than 3 days, consider discussing with the pediatric endocrinologist if concerns

5. Obtaining glucose samples

- a. Recommendation for heel puncture site in newborns
 - i. Perform punctures on the most medial or the most lateral portion of the plantar surface of the heel
 - ii. Diagram of appropriate sites:



- iii. Avoid puncture on other areas of the foot to prevent nerve damage or osteomyelitis
 - b. Preparation for heel puncture
 - i. Warm foot
 - ii. Keep extremity lower than the heart to increase venous pressure and facilitate blood flow
 - iii. Clean with alcohol and let air dry
 - iv. Puncture heel with sterile lancet
 - v. Wipe away first drop of blood and then collect specimen
 - vi. Apply pressure with sterile gauze and wrap with soft cotton wrapping
 - vii. Monitor sites for trauma
 - c. Appropriate lancet/method for POC sample
 - i. Small lavender/pink lancet
 - ii. Only need one for tiny amount of blood
 - d. Appropriate lancet/method for serum sample
 - i. Small green lancet (may need more than one)
 - ii. Gentle pumping of extremity above puncture site may encourage blood flow; to minimize edema, avoid excessive squeezing at the site
6. Obtaining the critical sample
- a. Nursing care:
 - i. If you anticipate that a critical sample is likely to be ordered (based on low glucose level and physician plan), place cotton balls in the diaper (alternatively a urine bag but this may be harder on the infant's skin) immediately to maximize chance of obtaining urine, in case TIER 3 labs are ordered (see Appendix B)
 - ii. Do not draw a critical sample unless preprandial POC glucose level is <45 mg/dL, there is a current physician order, and there is a standing plan or discussion with the physician
 - iii. Note the standard limits for neonatal blood draws (Appendix A)
 - iv. For requests for blood volume greater than the maximum reference range, please contact the physician for approval of the additional amount
 - v. Tips for obtaining the critical sample:
 - 1. When you have a PRN order for a critical hypoglycemia sample, gather the tubes ahead of time; sort out your requisitions and tube labels; be ready

2. Timing will be important; enlist help from your co-workers with blood draws and putting together the lab work
 3. Maintain awareness of infant clinical status and prioritize infant's clinical stability
 4. Adequately fill tubes; when short on blood, prioritize which labs to send but don't fill each tube with less blood
 5. While drawing labs, keep in mind this patient may need a PICC
- vi. Strategies to keep serum glucose <50 mg/dL during critical sample draw:
1. Do not use sweet-ease while drawing critical sample
 2. Keep neonate as calm as possible during lab draw, so as not to cause increase in glucose level related to metabolic response to stress in the infant (use warmth, swaddle, pacifier)
 3. If neonate is stable, temporarily discontinue dextrose fluids during the critical sample draw; this will prevent too high of glucose levels (>50 mg/dL) on the BMP which can negate results; do not discontinue fluids for longer than 10 to 15 minutes, the time it should take to get the labs
 4. Do not draw any critical sample labs after treating the neonate for hypoglycemia with sugar in any form
- b. Physician care:
- i. If hypoglycemia persists beyond 48 to 72 hours of life, consider pediatric endocrinology consultation and critical sample
 1. Discuss if/what labs within the critical sample (Appendix B) should be drawn and how to prioritize labs based on clinical scenario rather than drawing all of the critical sample at once
 2. Discuss whether a glucagon stimulation test is indicated prior to restarting dextrose fluids
 - ii. The decision to draw a critical sample should be based on clinical judgment and the need to guide decisions in clinical management
 - iii. The decision to draw a critical sample should balance the benefit of clinical investigating with the harm of excessive blood loss
 - iv. Note the standard limits for neonatal blood draws (Appendix A)
 - v. If indicated, ask for a critical sample to be drawn when glucose level is <45 mg/dL
 1. The goal is to obtain lab results while the serum glucose level is <50 mg/dL
 2. Serum glucose level <50 mg/dL is the level at which metabolic and neuroendocrine responses required for diagnosis are elicited

7. Other considerations

- a. If glucose levels remain persistently low despite appropriate interventions, consider sepsis evaluation: CBC, CRP, blood culture, consider urine or CSF studies as indicated
- b. Base decision to start broad spectrum antibiotics on screening labs and/or significant clinical deterioration

References:

1. Thornton, et al. Recommendations from the Pediatric Endocrine Society for Evaluation and Management of Persistent Hypoglycemia in Neonates, Infants, and Children. *The Journal of Pediatrics*, 2015. 167 (2):238-45.
2. Adamkin, et al. Clinical Report-Postnatal Glucose Homeostasis in Late-Preterm and Term Infants. *Pediatrics*, 2011. 127(3):575-79.
3. Seattle Children's Hospital (2020), Maximum Allowable Blood Draw From Infants, <https://seattlechildrenslab.testcatalog.org/show/1000721-1>
4. Children's Hospital of Minnesota (2020), Appropriate Maximum Phlebotomy Volumes, <https://childrensmn.org/departments/lab/pdf/phleb2.pdf>
5. Verklan, M.T., &Walden, M. (2015). Fluid & Electrolyte Management p. 146-152, Nutritional Management p. 175-178. Core curriculum for neonatal intensive care nursing, 5th ed. Saunders Philadelphia.

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Appendix A: Standard limits for neonatal blood draws.

Body wt in kg	Maximum drawn per day	Maximum drawn in a 30 day period
	2.5% of total blood volume	5% of total blood volume
1 kg	2.5 ml	5.0 ml
2 kg	4.5 ml	9.0 ml
3 kg	6 ml	12 ml
4 kg	8 ml	16 ml
5 kg	10 ml	20 ml
6 kg	12 ml	24 ml
7 kg	14 ml	28 ml
8 kg	16 ml	32 ml
9 kg	18 ml	36 ml
10 kg	20 ml	40 ml

Source: Seattle Children's Hospital, 2020

Appendix B: Critical hypoglycemia labs.

Typical Criteria: >48 to 72 hours old with blood glucose <45

Collect in stages/tiers based on clinical context. Consider whether a neonate requires a partial evaluation or full critical sample based on clinical scenario, neonate's personal and family history, exam findings, and pediatric endocrinology recommendations.

TIER 1:

SERUM LABS:

- 1.** Light green pedi tube x2: Draw 1.2 ml (fill tubes generously)
 - a. BMP
 - b. Cortisol
- 2.** Gold Pedi tube: Draw 1 ml
 - a. Insulin
 - b. Beta Hydroxybutyrate Ketone (due to testing shortages, if result reads ">1.56 mMol / L", lab must be called to report out more precise result)
- 3.** Gold top (Lab Corps send out): Draw 1 ml (use adult tube)
 - a. Growth hormone
 - b. Fatty acid

TIER 2:

SERUM LABS:

1. Heparinized blood gas syringe: Draw 1 mL (must be in lab within 30 minutes, do not use tourniquet)
 - a. Lactic acid

TIER 3:

SERUM LABS:

1. Lavender (purple) tube on ICE: Draw 1 mL (use adult tube, don't combine with CBC)
 - a. Ammonia level
2. Dark Green/Sodium heparin (LabCorp send out): Draw 1.5 mL (use adult tube)
 - a. Serum Amino Acids
 - b. Acylcarnitine profile
 - c. Carnitine, total and free

URINE LABS:

1. Urine organic acids, 10 mL (LabCorp send out)