



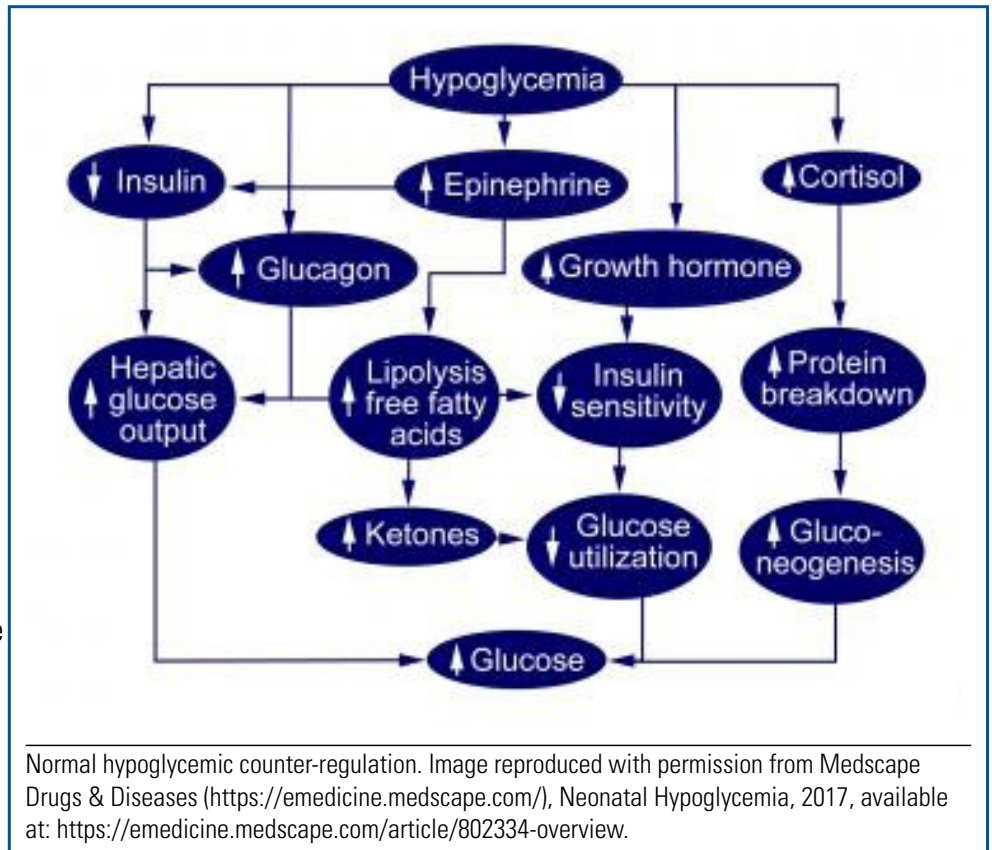
Hypoglycemia

An absolute blood or plasma glucose concentration that defines hypoglycemia in the neonate as a pathologic condition has not yet received universal consensus, with no one absolute value having been established. There have been “no evidence-based studies that can define what clinically relevant neonatal hypoglycemia is,” according to the American Academy of Pediatrics (AAP) Committee on Fetus and Newborn (2011). Many clinicians believe neonatal hypoglycemia is better determined by a continuum of low blood glucose values of varying duration and severity, rather than one specific value. Hypoglycemia also has been defined clinically as a glucose concentration in the neonate with associated clinical symptoms that resolve when treated with glucose therapies. Some institutions have established threshold targets within their neonatal population and have developed algorithms that drive the approach to appropriate screening and treatment.

A neonate’s blood sugar value can be influenced by a number of factors, including

- presence or absence of symptoms
- conceptual and postmenstrual age
- general health status and age of neonate
- adequacy of gluconeogenic pathways.

An essential part of the infant’s successful transition after birth is to be able to maintain a normal glucose level. Hypoglycemia occurs when there is not enough glucose in the blood, which then causes an alteration in organ system function.



Etiologies and Precipitating Factors

Normally, the body controls the level of serum glucose. When serum glucose is low, the body will release glucagon if it is available. Conversely, when serum glucose is elevated, the body will release insulin to drive glucose into cells, lowering the serum glucose level. Inadequate supply of glucose or inadequate glycogen stores account for the more common causes of neonatal hypoglycemia. These conditions include inadequate glycogen stores, abnormal endocrine regulation of glucose metabolism, and increased rate of glucose utilization.

Some examples of these conditions are

- prematurity—influenced by decreased or inefficient oral and parenteral intake, insufficient glycogen stores, and ability to release glucose



- intrauterine growth restriction and small for gestational age (SGA)—creates increased glucose utilization as well as low glycogen and fat stores
- nutritional issues—delayed feedings, fluid restriction, or insufficient breastfeeding are all important contributors.
- alteration in homeostasis of neonate—illness (e.g., sepsis), perinatal stress, or hypoxia, hypothermia, polycythemia, congenital cardiac anomalies, and endocrine disorders all impact availability of glucose stores and utilization.

The neonate also can have an increased uptake of glucose related to hyperinsulinism. Examples include

- infant of a diabetic mother and large for gestational age infants
- certain genetic syndromes such as Beckwith-Wiedemann or other autosomal recessive disorders thought to be caused by regulatory defects in beta cell function
- Rh incompatibilities (Gomella, Douglas Cunningham, & Eyal, 2013)
- iatrogenic causes such as a maternal tocolytics administered prior to birth, or positioning of an umbilical arterial catheter (UAC) tip near the pancreas.

Clinical sign and symptoms of hypoglycemia are nonspecific and may be present at varying blood glucose levels. Signs and symptoms of hypoglycemia include

- central nervous system signs such as tremors, jitteriness, irritability, exaggerated Moro reflex, high-pitched or weak cry, and seizures
- respiratory symptoms such as respiratory depression or apnea, tachypnea, or cyanosis
- hypothermia or temperature instability
- alteration in status such as hypotonia, lethargy, and refusal to feed.

Diagnosis

Laboratory measurements of serum glucose levels are the most reliable method for determining hypoglycemia. However, bedside glucose analyzers can provide key screening values if the test is performed carefully with

awareness of any limited accuracy for that particular device.

Most cases of neonatal hypoglycemia have an identifiable cause (e.g., infant of a diabetic mother, SGA). In the term infant with no known risk factors for hypoglycemia, sepsis must be considered as a possible cause of hypoglycemia. Use the following questions to evaluate the infant for other possible causes:

- Are dysmorphic features present?
- Is the neonate plethoric, suggesting polycythemia?
- Is the fetal growth pattern abnormal?
- Is the physical exam normal?

Treatment

Treatment options may include

- early and frequent feedings with breast milk, donor breast milk, or formula
- 40% glucose gel that may be administered on the buccal mucosa (in term and late preterm infants only)
- IV dextrose, which may include variation of concentrations depending on infant's condition and response to therapy
- adjunct therapies, which may also need to be implemented to adequately treat persistent hypoglycemia that is unresponsive to therapy, such as corticosteroids (describe why and when you might use each of these therapies)
- glucagon
- diazoxide.

The goal is to recognize at-risk infants, evaluate early and frequently for low serum glucose, treat when indicated, and provide glucose and enteral feeding as needed to achieve and maintain glucose concentrations in the range that are most desirable for the infant.

Clinicians should maintain a target glucose level that is considered acceptable and have a standardized protocol for treatment. The Pediatric Endocrine Society recommends that 50 mg/dL be the lower end of the threshold for infants at risk for hypoglycemia. Ongoing monitoring of the neonate's blood sugar should continue until the blood sugar is stable and the infant is able to



maintain stable blood sugar values with feedings of breast milk or formula only.

Complications

The outcomes for neonates with neonatal hypoglycemia appear to be related to the duration and severity of the hypoglycemia, repetitive reoccurrences, and the underlying etiology.

Reference

Gomella, T. L., Douglas Cunningham, M., & Eyal, F. G. (2013). *Lange neonatology: Management, procedures, on-call problems, diseases, and drugs* (7th ed, pp. 427–436). New York: McGraw Hill Medical.

Bibliography

Adamkin, D. H., Committee on Fetus and Newborn. (2011). Postnatal glucose homeostasis in late-preterm and term infants. *Pediatrics*, *127*(3), 575–579.

- Armentrout, D. (2014). Glucose management. In M. T. Verklan & M. Walden (Eds.), *Core curriculum for neonatal intensive care nursing* (5th ed., pp. 162–171). St. Louis, MO: Mosby Elsevier.
- Harris, D. L., Weston, P. J., Signal, M., Chase, J. G., & Harding, J. E. (2013). Dextrose gel for neonatal hypoglycemia (the Sugar Babies Study): A randomised, double-blind, placebo-controlled trial. *Lancet*, *382*(9910), 2077–2083. doi:10.1016/S0140-6736(13)61645-1
- Perinatal Continuing Education Program. (2016). *PCEP Book I: Maternal and fetal evaluation and immediate newborn care* (3rd ed., pp. 291–310). Elk Grove Village, IL: American Academy of Pediatrics.
- Rozance, P. J., McGowman, J., Price-Douglas, W., & Hay J. Jr. (2015). Glucose homeostasis. In S. L. Gardner, B. Carter, M. Enzman-Hines, & J. Hernandez (Eds.), *Merenstein & Gardner's handbook of neonatal intensive care* (8th ed., pp. 337–359). St. Louis, MO: Mosby Elsevier.
- Thornton, P. S. & Adamkin, D. Hypoglycemia guidelines: AAP vs. PES. contemporary pediatrics. Retrieved from <http://contemporarypediatrics.modernmedicine.com/contemporary-pediatrics/news/hypoglycemia-guidelines-aap-vs-pes> June 1, 2016



Hypoglycemia: Information for Parents

Definition

Glucose is a form of sugar in the blood and is a main source of fuel for all organs in the body, especially the brain. An important part of your baby's successful transition after birth is to be able to maintain a normal glucose level (aka "sugar" level) so his or her body safely adapts. Hypoglycemia occurs when there is not enough sugar in the blood. Hypoglycemia is difficult to define by an absolute number; many resources better define hypoglycemia by the presence of particular signs or symptoms.

Causes

Normally, your baby's body will naturally try to control the level of glucose in the blood. When there is not enough glucose (hypoglycemia), his or her body will release stored sugar. When there is too much sugar, the body will release insulin to help lower the glucose level. It is common for newborns to experience low blood sugar levels soon after birth. This is usually a temporary situation as a newborn's body tries to adjust the blood sugar level.

Factors that can increase your baby's risk of hypoglycemia due to low glucose stores include

- premature birth
- low birth weight
- situations that use high amounts of glucose, such as stress during delivery, temperature of the environment making your baby's temperature drop, infection, fever, respiratory distress, and seizures
- birth defects
- certain conditions in which the infant has been exposed to high insulin levels, such as the mother having diabetes, the infant being large for gestational age, and certain syndromes.

Symptoms

Symptoms of hypoglycemia your baby might have include

- irritability (i.e., not being consoled easily)
- trembling or jitteriness
- abnormal cry (high pitched or weak)
- seizures

- bluish skin
- refusal to feed
- breathing problems
- abnormal vital signs, such as low temperature.

Diagnosis

Your baby will receive a full exam and a medical history will be obtained in order to make the diagnosis. Your baby's blood will be tested to determine a glucose value. Your care provider will want to determine the cause of your baby's low blood sugar. Based on the cause(s), your baby will receive tests and therapies that will best treat the low blood sugar.

Treatment

Talk with your baby's care provider about the best treatment plan for your baby. Treatment will focus on increasing the glucose in your baby's blood. Underlying issues also may need to be treated. Options may include

- frequent feedings and therapies—Frequent feedings may help raise blood glucose levels in your baby. Your baby may also be given glucose in to their blood system through an intravenous (IV) catheter. This may be done until your baby's blood glucose level is stable.
- medications—Certain medications may be needed if your baby continues to have low blood sugars despite frequent feedings or IV treatment. Your care provider will discuss these medications with you to provide specific information on the medications your baby needs.

Ongoing monitoring of your baby's blood sugar should continue until the blood sugar is stable and your baby has stable blood sugar values with only feedings of breast milk or formula.

Prevention

- Feed your baby early and often.
- Watch your infant for any of the above signs and symptoms and report them immediately to your care team.
- Keep your baby warm and follow your nurses' instructions for skin-to-skin with your baby.