

Fasting Study for the Evaluation of Hypoglycemia in Pediatric Patients: Inpatient Unit Management Clinical Guideline

This guideline was developed to ensure the proper diagnostic evaluation of **hypoglycemia in pediatric patients**. Please direct questions and patient referrals to Dr. Alan Morris or Dr. Jerry Olshan, Pediatric Endocrinologists at The Barbara Bush Children's Hospital and Maine Pediatric Specialty Group, 207.662.5522.

For management of neonatal hypoglycemia, see the guideline entitled "Newborn Hypoglycemia Guideline."

Definition: The definition of hypoglycemia in infants and children continues to be controversial. The physiologic nadir of plasma glucose occurs in the first 2 - 4 hours life, but, normally, increases to values > 60 mg/dL by 6 hours of life. Any documented plasma glucose level ≤ 40 mg/dL at any time after the physiologic nadir warrants further evaluation.

- Normal > 70 mg/dL
- Hypoglycemia < 60 mg/dL
- With illness or fasting < 50 mg/dL

Autonomic Symptoms	Neuroglycopenic Symptoms
<ul style="list-style-type: none"> • Sweating • Hunger • Paresthesias • Tremors • Pallor • Anxiety • Nausea 	<ul style="list-style-type: none"> • Fatigue • Weakness • Dizziness • Confusion • Headache • Irritability • Coma • Seizures

Purpose of the fasting study: The purpose of a fasting study is to systematically pinpoint the etiology of the hypoglycemia (first, by confirming the hypoglycemic state and, then, by obtaining critical blood and urine samples). The key historical clue to the etiology of hypoglycemia is the duration of fasting before hypoglycemia occurs. The duration of fasting may direct the laboratory studies you order.

Duration of Fasting	Predominant Fuel	Disorders
0 - 2 hours	Sugars from meals	Malabsorption Hyperinsulinism
2 - 6 hours	Glycogen	Glycogen storage disease (GSD) Hyperinsulinism Glucagon Deficiency
6 - 12 hours	Gluconeogenesis	Hyperinsulinism Gluconeogenesis disorder GSD 0
12 - 24 hours	Fatty acid oxidation (FAO)	Hyperinsulinism FAO disorders (FAOD) Growth hormone and/or cortisol deficiency

Before Admission: The patient should be on a high-carbohydrate diet (> 60% CHO) for 3 days prior to admission.

At admission: The fasting study will **generally start at 18:00 (just after dinner)** and last about 18 hours for patients under 4 years of age, or 24 - 36 hours for patients 4 years of age and older. A typical fast for a suspected fatty oxidation disorder is 14 - 16 hours.

1. Order a low-fat/**high carbohydrate diet** for up to 6 hours prior to beginning the controlled fast.
2. Start an **IV** for blood draws, with a stopcock setup.
 - a. Consider a **second IV** to administer **non-glucose containing IV fluids** if the patient is unwilling or unable to maintain hydration.
3. If the child is an infant, a **Foley catheter** may be placed.
4. **Discuss with the endocrinologist** the entire plan, including whether or not to perform a glucagon stimulation test after the fasting portion of the study.

KEY: *It may be somewhat risky to undertake a glucagon stimulation test in patients who are not hyperinsulinemic because the serum glucose may continue to fall to dangerously low levels during the subsequent 10 - 15 minute period following glucagon administration.*
5. Phone the laboratory and notify the lab supervisor that a pediatric patient is undergoing a hypoglycemia evaluation.
6. Calculate the appropriate dose of glucagon, and order it "**OnCall**" at the bedside.
 - a. **Glucagon dose is 30 mcg/kg** (to a max of 1 mg) by slow IV push or IM injection.

7. **Notify the nurse of the entire plan** for the study:
 - a. **Post a sign on the door:** "NPO except for water ad lib, starting after 18:00." This remains in effect until the physician terminates the study.
 - b. **Notify the house officer if the patient displays signs of hypoglycemia at any time.**
 - c. When to check fingerstick glucose versus draw labs.
 - d. When to administer glucagon, if applicable.
8. **VERY IMPORTANT:** Discuss with the parents that throughout the study, the **child is to remain NPO except water until the labs are drawn**. Frequently, the parents have been told to give their child carbohydrates immediately if a low glucose is discovered. Let all parties know that the physician will administer glucagon *instead* of offering oral/IV carbohydrates at the appropriate moment.

Initiation of fasting study:

1. Just before the last meal, a **full blood draw and urine** will be sent. Refer to the Hypoglycemia – Fasting Study Roadmap for initial blood and urine tests. Then, the child may have **dinner**.
2. "Time zero": The clock starts after the last bite of dinner. After that meal, the patient is to be **NPO (except for water ad lib)**.
3. **Every 2 hours** for the remainder of the study, check a **fingerstick blood glucose**.
4. At **every void** for the remainder of the study, check **urine ketones**.
 - a. If the patient has a Foley catheter, check urine for ketones every 4 hours.
 - b. Urine should be collected by bag if there is no Foley catheter in place.
5. **If the patient does not become hypoglycemic:** Obtain **blood and urine at 12, 18, 24 and 36 hours**. Not all tests may be necessary at each of these times. Each fasting study will be individualized to the patient and clinical presentation. Discuss with the endocrinologist and refer to the table for studies to be ordered at each of these times.
6. **If at any point the fingerstick BG < 60 mg/dL:** **Draw a STAT blood glucose** to confirm hypoglycemia and begin **q15 minute fingerstick blood glucose testing**.
KEY: *Stat serum glucose may be obtained quickly if drawn in a green top lithium/heparin tube and ordered as a "pedi glucose" or as a "profile N."*
7. **If the lab glucose is < 50 mg/dL:** Refer to the table and obtain a **full blood draw and urine**. **Inform the endocrinologist**, who will authorize you to proceed to the glucagon stimulation test if indicated.
KEY: *Do not allow the child to eat.*
KEY: *Continue q15 min fingerstick glucose levels.*
8. **If at any time the patient develops severe symptoms of hypoglycemia (i.e. convulsions, coma):**
 - a. **Notify the house officer immediately.**
 - b. Obtain **full blood draw and urine** if possible.
 - c. **Notify Endocrinologist** to discuss glucagon versus IV dextrose (3 ml/kg D10W IV push and recheck fingerstick glucose in 15 minutes).

Glucagon Stimulation Test: Whenever the patient has a documented blood glucose < 50 mg/dL, the patient may undergo a glucagon stimulation test. This test should be determined by the Endocrinologist before the onset of the study.

1. Give **30 mcg/kg of glucagon** (to a max of 1 mg) by slow IV push or IM injection.
2. Measure **bedside glucose and lab blood glucose and insulin at 0, 10, 20, and 30 minutes** after glucagon injection.
3. **If patient develops severe symptoms of hypoglycemia (convulsions, coma)** during the glucagon stimulation test, terminate the test and infuse **3 ml/kg D10W IV push**, then recheck fingerstick glucose in 15 minutes.

Algorithms are not intended to replace providers' clinical judgment or to establish a single protocol. Some clinical problems may not be adequately addressed in this guideline. As always, clinicians are urged to document management strategies.

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