

# Hypoglycemia

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## THE STORY IN ONE SENTENCE

Blood sugar below 70 mg/dL with symptoms, or below 55 mg/dL even without symptoms, means the brain and body are starving for fuel right now.

“Blood sugar dropped too low. Give glucose immediately. Figure out the cause afterward.”

## Normal anatomy — the body's job

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Your body keeps blood sugar steady between 70 and 100 mg/dL all day and night using a careful balance of hormones and organs working together like a thermostat.

## BODY'S JOB

The pancreas releases insulin (lowers sugar by pushing it into cells for fuel or storage) when you eat, and glucagon (raises sugar by telling the liver to release stored sugar) when you haven't eaten for a while. The liver stores sugar as glycogen and can make new sugar from protein. The adrenal glands release cortisol and adrenaline to raise blood sugar during stress or fasting. The pituitary gland directs the adrenals and keeps the whole system in balance. Your brain and heart depend completely on this steady sugar supply—they have no backup fuel.

1. After you eat, blood sugar rises and the pancreas releases insulin to move sugar into muscle, fat, and liver cells.
2. The liver stores extra sugar as glycogen (a starch-like backup fuel).
3. Between meals, blood sugar starts to fall and the pancreas releases glucagon, which tells the liver to break down glycogen and release sugar back into the blood.
4. If you fast for many hours, the liver makes new sugar from protein (a process called gluconeogenesis) to keep the brain and heart fed.
5. If blood sugar drops suddenly or you face stress, the adrenal glands dump adrenaline and cortisol to raise sugar fast.

6. The pituitary gland (at the base of the brain) watches the whole system and signals the adrenals and other glands to keep balance.

## What breaks

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Blood sugar drops too low when the system that raises or stores sugar breaks, or when something pushes sugar down too hard.

### CLINICAL TERM

Low blood sugar (Hypoglycemia) (blood sugar below 70 mg/dL with symptoms, or below 55 mg/dL without symptoms).

## How the body compensates

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The body fights low blood sugar by releasing adrenaline and cortisol to raise it fast, but if the cause keeps pushing sugar down or the backup systems are broken, compensation fails and the brain starves.

1. {'step': 'Blood sugar starts to drop below 70 mg/dL.', 'why': 'The pancreas stops releasing insulin and starts releasing glucagon to tell the liver to release stored sugar.'}
2. {'step': 'The adrenal glands dump adrenaline (epinephrine) into the blood.', 'why': 'Adrenaline is the body's emergency alarm: it makes the heart race, triggers sweating, causes shaking, and tells the liver to release sugar fast. These symptoms warn you that blood sugar is low.'}
3. {'step': 'The liver breaks down glycogen and releases sugar into the blood.', 'why': 'Glucagon and adrenaline signal the liver to use its stored backup fuel to raise blood sugar.'}
4. {'step': 'If blood sugar keeps falling, the adrenals release cortisol to raise sugar over hours.', 'why': 'Cortisol tells the liver to make new sugar from protein and blocks insulin from pushing sugar into cells.'}
5. {'step': 'Compensation fails when the liver is too sick to release or make sugar, the adrenals or pituitary are broken, or insulin/sulfonylurea keeps pushing sugar down faster than the body can raise it.', 'why': 'The backup systems run out of fuel or are blocked, so blood sugar keeps falling despite the body's alarms.'}
6. {'step': 'Blood sugar drops below 55 mg/dL and the brain itself starts to fail.', 'why': 'The brain runs only on sugar and has no stored fuel. When sugar is too low, brain cells cannot make energy, so confusion, seizures, or coma follow.'}

7. {'step': 'The crash point: seizure, coma, permanent brain damage, or death if blood sugar stays below 40 mg/dL for too long.', 'why': 'Brain cells die when they have no fuel. The longer the brain starves, the more cells die, and damage becomes permanent.'}

## Domino effect

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1. Blood sugar drops below 70 mg/dL (or below 55 mg/dL even without symptoms). — Insulin overdose, sulfonylurea medicine, alcohol blocking the liver, liver or kidney failure, adrenal or pituitary failure, an insulin-making tumor, severe infection, or starvation breaks the system that keeps blood sugar steady. The brain and heart depend completely on sugar for fuel, so they send out an emergency alarm.
2. The adrenal glands release adrenaline (epinephrine) into the blood. — Adrenaline is the body's emergency signal to raise blood sugar fast and warn you something is wrong. It tells the liver to dump stored sugar and makes your heart race, your hands shake, and your skin sweat. These symptoms are the body's alarm, not the disease itself.
3. You feel shaky, sweaty, hungry, and your heart races (adrenergic symptoms). — Adrenaline floods your system to raise blood sugar and get your attention so you eat or get help. This is the body buying time before the brain runs out of fuel.
4. If blood sugar stays low, the brain itself starts to fail: you get confused, dizzy, weak, or have trouble speaking (neuroglycopenic symptoms). — The brain has no backup fuel and cannot make energy when blood sugar is too low. Brain cells in the cerebral cortex (the thinking and speaking part) and hippocampus (the memory center) fail first, so confusion and memory loss appear.
5. Blood sugar drops below 40 mg/dL: you have a seizure, lose consciousness, or fall into a coma. — Brain cells are starving and misfiring. The cerebral cortex cannot control movement or stay awake, so seizures or coma follow. The longer the brain starves, the more cells die.
6. Without treatment, permanent brain damage or death occurs. — Brain cells in the hippocampus and cortex die when they have no fuel for too long. Damage becomes permanent if blood sugar stays critically low for more than 30 to 60 minutes.
7. When you give glucose (by mouth, IV dextrose, or glucagon injection), blood sugar rises, the brain gets fuel again, and symptoms reverse—often in minutes. — Glucose is the fuel the brain and heart need. Once it arrives, brain cells make energy again, the emergency alarm (adrenaline) shuts off, and every symptom (shaking, confusion, seizure) stops. This rapid reversal proves low blood sugar was the true cause all along.

## Symptoms · what the patient feels, and why

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- **Shakiness or trembling:** When blood sugar drops, the adrenal glands (small triangle-shaped glands above the kidneys) dump out epinephrine (also called adrenaline, the body's alarm hormone). Epinephrine fires up muscles and makes them twitch and shake, getting the body ready to fight or run. This shake is the body's way of shouting 'we need fuel now.'
- **Sweating without being hot:** Epinephrine also turns on sweat glands all over the skin. The body treats low blood sugar like an emergency, so it starts sweating just like it would if you were in danger. This sweat is cold and clammy, not warm like when you exercise.
- **Fast heartbeat or pounding in the chest:** Epinephrine tells the heart to speed up and pump harder to push whatever glucose is left in the blood to the brain as fast as possible. The brain runs entirely on glucose (blood sugar), so the body protects it first when fuel runs low.
- **Hunger that comes on suddenly:** The hypothalamus (the brain's control center for hunger and many body needs) senses the drop in blood sugar and triggers a strong hunger signal. The body is demanding food to bring glucose levels back up quickly.
- **Feeling dizzy, lightheaded, or confused:** The brain uses glucose as its only fuel. When blood sugar falls too low, brain cells start to run out of energy. The parts that handle clear thinking, balance, and staying alert slow down first, like a phone going into low-power mode.
- **Blurry vision or trouble seeing clearly:** The parts of the brain that process what your eyes see (the occipital cortex at the back of the brain) need a steady glucose supply to work. When glucose drops, those areas can't fire correctly, so vision gets fuzzy or doubled.
- **Trouble speaking clearly or slurred words:** The motor cortex (the strip of brain that controls muscles for speech and movement) runs out of fuel. Without enough glucose, the signals to the tongue and mouth muscles get weak and sloppy, making words come out garbled, just like in a stroke.
- **Sudden weakness or feeling like your legs might give out:** Muscles need glucose to contract. When blood sugar is very low, muscles lose their fuel and feel heavy or rubbery. At the same time, the brain's signals to those muscles get weaker, so standing or walking becomes hard.
- **Seizure (jerking movements or loss of awareness):** If blood sugar drops dangerously low (usually below 40 mg/dL), brain cells become so starved that electrical signals fire in wild, uncontrolled bursts. This chaotic firing is a seizure. The brain is literally short-circuiting from lack of fuel.
- **Loss of consciousness or passing out:** When blood glucose falls to critical levels (often below 30 mg/dL), the brain cannot generate enough energy to stay awake. The person becomes unresponsive, just like a computer shutting down when the battery dies. This is a life-threatening emergency.

## Focused exam

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- Shaking and tremor all over the body: The body is dumping adrenaline (the main fight-or-flight hormone) because blood sugar dropped too low. Adrenaline makes muscles shake to wake you up and push you to eat. This is the alarm bell that the brain is starving for fuel.
- Heart racing fast (tachycardia) — you can feel it or count it at 100+ beats per minute: Adrenaline makes the heart pump harder and faster to push whatever glucose is left to the brain. This is the body fighting back against low blood sugar, not a separate heart problem.
- Sweating a lot, especially on the forehead and palms, even when it is not hot: Adrenaline opens sweat glands wide when blood sugar crashes. This sweat is cold and clammy, not from fever or exercise — it is from the stress hormone trying to save you.
- Confusion, slurred speech, or acting like you are drunk when you have not had any alcohol: The brain runs only on glucose. When blood sugar drops below 55 mg/dL, the brain cannot think straight because it does not have enough fuel. This is low blood sugar (hypoglycemia) hurting the brain right now.
- Seizures or loss of consciousness: This means low blood sugar (hypoglycemia) is severe and the brain is failing. Glucose below 40 mg/dL can cause seizures or coma. This is a true emergency — the patient can die or have permanent brain damage if you do not fix it in minutes.
- Feeling better and thinking clearer within 10–15 minutes of eating or getting glucose: This is the proof that low blood sugar (hypoglycemia) was the problem. No other condition fixes this fast with sugar. If they do not get better, you were wrong about the diagnosis or something else is happening at the same time.

## Diagnostics · every test answers a question

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- Fingerstick (capillary) blood glucose → Is blood sugar low right now, and how low is it?
- Serum glucose (venous blood draw) → What is the exact blood sugar level when symptoms are happening, especially if the fingerstick result does not match the symptoms?
- Insulin level (measured during low blood sugar (hypoglycemia)) → Is the body making too much insulin or is someone getting too much injected insulin?
- C-peptide level (measured during low blood sugar (hypoglycemia)) → Is the insulin coming from the patient's own pancreas or from injections?
- Beta-hydroxybutyrate (ketone level) → Is the body burning fat for fuel because it cannot get glucose, or is something blocking fat breakdown?
- Sulfonylurea and meglitinide screen (urine or blood) → Did the patient take a diabetes pill that forces the pancreas to make too much insulin?

- Cortisol and ACTH (if low blood sugar (hypoglycemia) keeps happening and no other cause is found) → Is the adrenal gland making enough cortisol (the body's main stress hormone that keeps blood sugar steady)?
- Abdominal CT or MRI with contrast (if insulinoma is suspected) → Is there a tumor in the pancreas that is making too much insulin?

## Treatment logic

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- 15–20 grams of fast-acting glucose by mouth (glucose tablets, juice, regular soda, honey) if the patient is awake and can swallow safely → Raises blood sugar directly within 10–15 minutes. The glucose goes straight from the stomach into the bloodstream and feeds the brain. Adrenaline shuts off, shaking stops, and confusion clears because the body has fuel again.
- 25 grams of IV dextrose (one amp of D50 in 50 mL, given through a vein) if the patient cannot swallow, is unconscious, or is having a seizure → Bypasses the mouth and stomach and puts sugar directly into the bloodstream in seconds. Blood sugar rises fast, the brain wakes up, and seizures stop. This is the fastest way to save the brain when the patient cannot help themselves.
- 1 mg glucagon injection (intramuscular or subcutaneous) if IV access is not available and the patient is unconscious → Tells the liver to dump stored glucose (glycogen) into the bloodstream. Blood sugar rises in 10–15 minutes without needing a vein. This is the home rescue option for severe low blood sugar (hypoglycemia) when paramedics are not there yet.
- Recheck blood glucose 15 minutes after giving glucose; if still below 70 mg/dL, give another 15–20 grams and recheck again → Confirms the blood sugar came up and symptoms will stop. Prevents the blood sugar from crashing again before you fix the cause. Most patients need only one dose, but some need two or three if low blood sugar (hypoglycemia) is severe or caused by long-acting insulin.
- Find and treat the cause: reduce or stop insulin or sulfonylurea dose, feed the patient regular meals and snacks, check liver and kidney function, treat infection or sepsis, stop alcohol, or give octreotide 50–100 micrograms subcutaneously every 6–12 hours if sulfonylurea overdose → Stops the upstream problem so low blood sugar (hypoglycemia) does not happen again. Octreotide blocks the pancreas from making insulin if a diabetes pill overdose is the culprit. Fixing the cause is the only way to prevent the next crash.
- Teach the patient and family to recognize early warning signs (shaking, sweating, fast heart, hunger, confusion), carry fast glucose at all times, and use a glucagon emergency kit at home → Empowers the patient to treat themselves the moment symptoms start, before confusion or seizure happens. A glucagon kit at home is a safety net if they pass out and no one can start an IV.

- Admit to the hospital and start continuous IV dextrose infusion (D10 at 75–150 mL/hour) if low blood sugar (hypoglycemia) keeps coming back, is caused by long-acting insulin or sulfonylurea, or the patient cannot eat → Keeps blood sugar steady by dripping glucose into the vein around the clock. Buys time to find and fix the cause safely. Prevents repeated crashes that can cause brain damage.

## Medications

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### Oral glucose (15–20 grams) · Simple carbohydrate

This is pure sugar you swallow—glucose tablets, juice, or candy. It moves straight from your stomach into your blood within minutes, bringing blood sugar back up fast. It works only if you are awake enough to swallow safely.

1. You swallow 15–20 grams of fast-acting sugar (about 4 glucose tablets, half a cup of juice, or 3–4 hard candies).
2. The sugar dissolves in your stomach and moves into your small intestine.
3. The cells lining the small intestine pull the glucose straight into your blood.
4. Within 10–15 minutes, blood glucose rises, feeding your brain and muscles.
5. After 15 minutes, you recheck blood sugar; if it is still low, you repeat the same dose once.

#### SAFETY WATCH

Only use if the person is awake and can swallow without choking. · Avoid chocolate or fat-heavy foods for the first dose—they slow absorption. · Recheck blood sugar 15 minutes after the dose; do not guess by symptoms alone. · If still below 70 mg/dL after one repeat, call for help or use injectable treatment.

### Dextrose 50% (D50), 1 ampule (25 grams) intravenous · Intravenous concentrated glucose

This is a thick sugar solution injected directly into a vein. It bypasses the stomach and dumps glucose straight into the bloodstream, raising blood sugar within 1–2 minutes. It is used when someone cannot swallow or is unconscious.

1. A healthcare provider puts an IV line into a vein.
2. One ampule (25 grams of glucose in a thick liquid) is pushed slowly into the vein.
3. Glucose floods the bloodstream instantly, feeding the brain and muscles.
4. Blood sugar rises within 1–2 minutes; symptoms such as confusion or sweating usually improve quickly.

5. The provider rechecks blood sugar within 10–15 minutes and may give more if needed or start a continuous sugar drip to prevent another drop.

**SAFETY WATCH**

Must be given into a vein—if it leaks into the tissue around the vein, it can damage skin and muscle. · Can cause a brief spike in blood sugar, then a second drop if the underlying cause is not fixed. · After the first dose, many people need a continuous glucose drip (D5W or D10W) or food to keep sugar stable. · Not safe to give at home—requires trained medical personnel and IV access.

**Glucagon, 1 mg injection (intramuscular or subcutaneous) · Hormone that signals the liver to release stored sugar**

Glucagon is a natural hormone your pancreas makes to raise blood sugar. The injection version tells your liver to break down its stored sugar (glycogen) and dump it into the blood. It works in 10–15 minutes and does not require the person to be awake or able to swallow.

1. A family member or responder injects 1 mg of glucagon into the muscle (thigh, upper arm, or buttock) or under the skin.
2. Glucagon travels through the bloodstream to the liver.
3. It locks onto receptors on liver cells and flips on the enzyme (glycogen phosphorylase) that breaks glycogen into glucose.
4. The liver pours glucose into the blood.
5. Blood sugar rises within 10–15 minutes; the person usually wakes up and can then eat or drink.

**SAFETY WATCH**

Does not work if the person has been drinking alcohol recently—the liver cannot respond. · Does not work in starvation or very low-carb diets with empty liver glycogen stores. · After giving glucagon, turn the person on their side (recovery position) in case they vomit. · Once awake, give fast-acting carbs by mouth, then a longer-lasting snack to prevent another drop. · Call emergency services if the person does not wake within 15 minutes.

**Octreotide, 50–100 mcg subcutaneous every 6–12 hours · Somatostatin analog (hormone blocker)**

Octreotide is a lab-made copy of somatostatin, a natural hormone that tells the pancreas to stop releasing insulin. It is used for low blood sugar (hypoglycemia) caused by sulfonylurea pills (such as glyburide or glipizide), which force the pancreas to keep squeezing out insulin

even when blood sugar is already low. Octreotide slams the brakes on that unwanted insulin release.

1. Octreotide is injected under the skin, usually in the abdomen or thigh.
2. It travels to the pancreas and locks onto somatostatin receptors on the insulin-making beta cells.
3. It blocks the beta cells from releasing more insulin, even though the sulfonylurea drug is still trying to force them.
4. Insulin levels drop, so the liver and muscles stop pulling glucose out of the blood.
5. Blood sugar stabilizes and stops crashing every few hours.
6. Doses are repeated every 6–12 hours until the sulfonylurea clears from the body (which can take 24–72 hours for long-acting pills).

#### **SAFETY WATCH**

Reserved for sulfonylurea overdose or poisoning—not used for routine insulin-induced lows. · Can cause nausea, stomach cramps, or diarrhea. · May need to continue for 1–3 days depending on which sulfonylurea was taken (long-acting drugs linger). · Requires hospital monitoring and repeated blood sugar checks. · Does not replace the need for IV dextrose or a continuous glucose infusion in the first hours.

### **Continuous intravenous dextrose infusion (D5W or D10W) · Intravenous maintenance glucose solution**

This is a steady drip of sugar water into a vein, used when low blood sugar (hypoglycemia) keeps coming back—such as after a large insulin dose, sulfonylurea overdose, or in someone who cannot eat. It delivers a constant trickle of glucose to keep blood sugar from crashing again while the body clears the cause.

1. An IV line is placed, and a bag of dextrose solution (5% or 10% glucose in water) is hung.
2. The solution drips into the vein at a controlled rate, delivering glucose minute by minute.
3. Blood sugar is checked every 1–2 hours at first, and the drip rate is adjusted to keep glucose in a safe range (usually 100–200 mg/dL).
4. The infusion continues until the person can eat safely and the underlying cause (such as too much insulin) has worn off.
5. Once stable, the drip is tapered and stopped, not turned off suddenly, to avoid rebound low sugar.

**SAFETY WATCH**

Requires hospital setting with frequent blood sugar checks—home use is not safe. · If the drip runs too fast, blood sugar can spike and cause other problems; if too slow, it can drop again. · Must not be stopped abruptly—taper the rate first to let the body adjust. · Watch the IV site for redness, swelling, or pain (sign the line has moved out of the vein). · Keep checking for the cause—infusion is support, not a cure.

## Red flags

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- Confusion, slurred speech, or not acting like yourself (the brain is running out of fuel)
- Seizure or uncontrollable shaking (brain cells are firing wildly from severe glucose starvation)
- Loss of consciousness or cannot be woken up (immediate emergency — give glucagon injection or call 911)
- Low blood sugar (Hypoglycemia) happening often without a clear reason (may signal an insulin-producing tumor, adrenal failure, or liver disease)
- Severe low blood sugar after drinking alcohol (alcohol blocks the liver from making new glucose)

## Nursing priorities

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1. Check blood glucose with a fingerstick meter immediately, before giving any treatment — You must confirm low blood sugar (hypoglycemia) with a number under 70 because many conditions mimic the shaking and sweating (like anxiety or stroke); treating without checking wastes time if the diagnosis is wrong, and documenting the exact glucose level guides how much dextrose or glucose to give
2. Give 15 to 20 grams of fast-acting carbohydrate by mouth if the patient is awake and can swallow safely (4 glucose tablets, half cup of juice, or 1 tablespoon of sugar dissolved in water) — Glucose absorbed through the stomach reaches the bloodstream in 10 to 15 minutes and raises blood sugar about 30 to 50 points; simple sugar works faster than complex carbs like crackers because it needs no digestion, and this dose avoids overshooting into high blood sugar (hyperglycemia) (high blood sugar)

3. If the patient cannot swallow or is unconscious, establish IV access and push one amp of D50 (50 percent dextrose, 25 grams of sugar in 50 mL) over 3 to 5 minutes, or give 1 mg glucagon intramuscular injection if no IV is available — The brain suffers irreversible damage after 30 minutes without glucose, so IV dextrose delivers sugar directly to the bloodstream in under one minute; glucagon is a hormone that tells the liver to dump stored glycogen into the blood as glucose within 10 to 15 minutes when you cannot start an IV quickly
4. Recheck blood glucose exactly 15 minutes after giving glucose or dextrose, and repeat the same dose if the level is still under 70 — The rule of 15 (15 grams, wait 15 minutes, recheck) prevents giving too much sugar too fast while confirming the treatment worked; if glucose does not rise, the patient may need continuous IV dextrose because the cause (like long-acting insulin or alcohol) is still active
5. Once blood sugar is above 70 and stable, give a snack with protein and complex carbohydrate (like cheese and crackers or peanut butter and bread) within 30 minutes — Simple sugar from the emergency treatment burns off in 30 to 60 minutes, but protein and starch digest slowly and release glucose over 2 to 3 hours to prevent another drop; this bridges the gap until the next full meal
6. Monitor blood glucose every 15 minutes for the first hour, then hourly for 4 hours after the episode, watching for repeat lows — Sulfonylureas like glyburide stay active for 12 to 24 hours, and long-acting insulins (glargine, degludec) last up to 42 hours, so low blood sugar (hypoglycemia) often recurs; catching the second drop early prevents seizures and allows you to start a dextrose drip if oral feeding is not enough
7. Identify and document the cause (missed meal, wrong insulin dose, new medicine, infection, alcohol, exercise), and notify the provider to adjust the diabetes treatment plan — Low blood sugar (Hypoglycemia) means the current medicine dose is too strong for the patient's food intake and activity level; repeating the same regimen guarantees another dangerous low, so the provider must reduce insulin or sulfonylurea doses or change the timing
8. Teach the patient and family to recognize early symptoms (shakiness, sweating, hunger, confusion), carry glucose tablets or candy at all times, and wear a medical alert bracelet — Autonomic symptoms (the body's adrenaline response with tremor and sweat) appear when glucose drops toward 55 and give a 10 to 15 minute warning before confusion sets in; self-treating early prevents emergencies and empowers patients to manage lows independently at home or work

## Sources

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- American Diabetes Association Standards of Care 2024
- Endocrine Society Clinical Practice Guideline on Hypoglycemia

- AMA
- UpToDate

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