# Growth Hormone

BCH 120 — Metabolic & Endocrine Biochemistry · Dr. Radi

# By the end of this unit, you can…

- Describe GH production (somatotropes) and its regulation (GHRH/ghrelin push; somatostatin/IGF-1 brake; pulsatile, sleep-linked), plus the CJD history and the IGF-1 mediator
- Explain that GH acts largely through liver-made IGF-1 (JAK-STAT receptor), its metabolic effects (anabolic but anti-insulin/diabetogenic), and the IGF-1 negative-feedback loop
- Analyze GH disorders (deficiency; gigantism vs acromegaly by growth-plate timing) and the lifestyle factors (sleep, exercise, fasting, stress/cortisol) that modulate GH

# Today's route

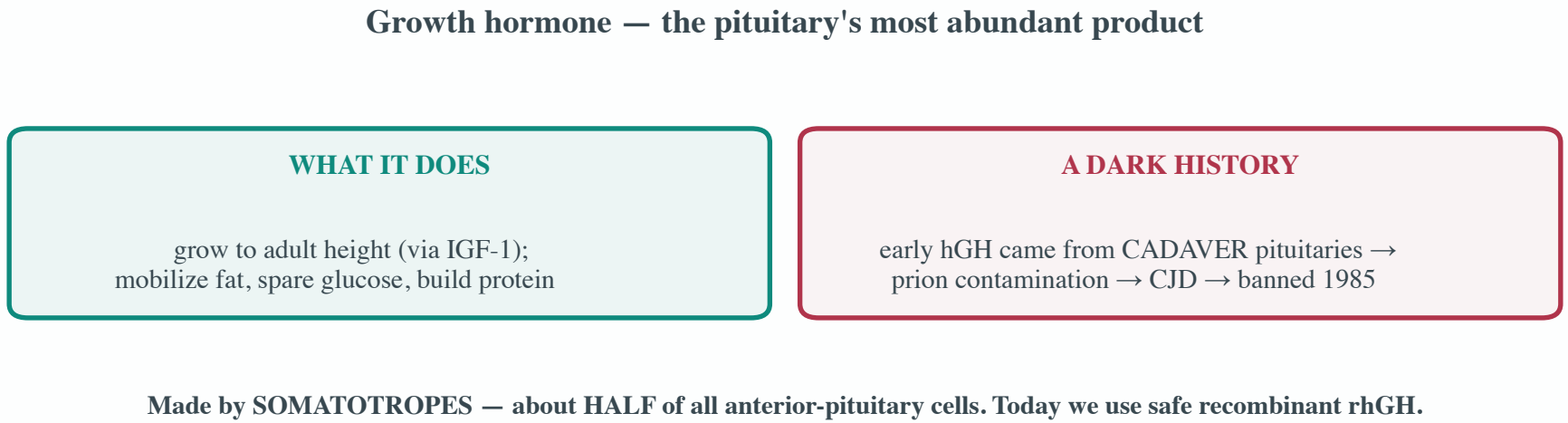
1. **Growth Hormone — Production & Regulation**
2. **GH's Metabolism & IGF-1 Feedback**
3. **GH Disorders & Lifestyle**

# 1 · Growth Hormone — Production & Regulation

"Growth hormone is the pituitary's most abundant product, and its story has a dark chapter (CJD from cadaver extracts). But the biochemistry is elegant: a push-pull control panel, a nightly pulse, and a hidden middleman that does the actual growing."

# GH — the most abundant pituitary hormone

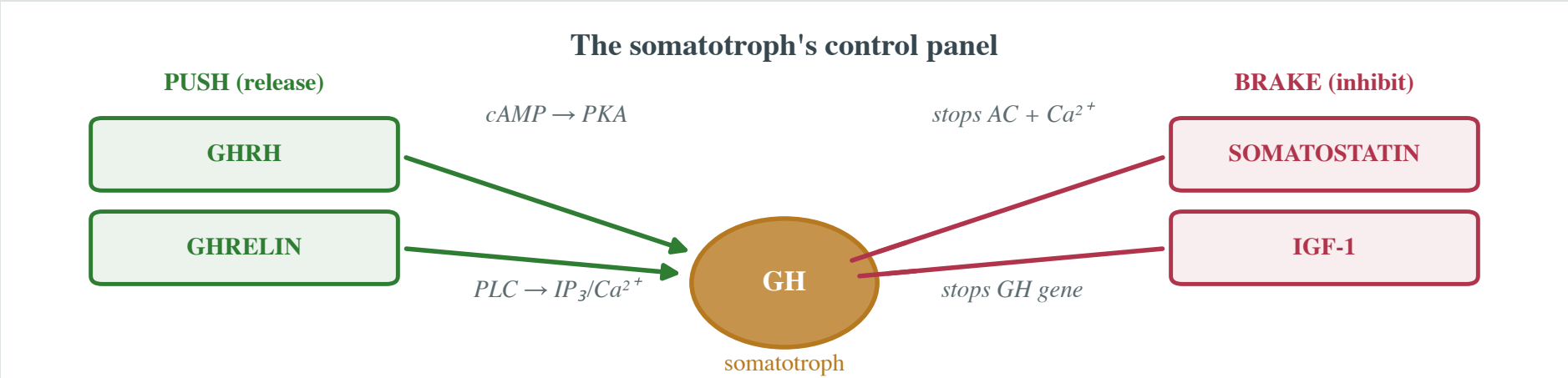
**Growth hormone (GH)** is made by **somatotropes**, which make up about **half** of all anterior-pituitary cells — it's the **most abundant pituitary hormone**. Its job is to drive you to **adult height** (indirectly) and to run a metabolic program: **mobilize fat, spare glucose, and build protein**. It also carries a **cautionary history**: early hGH was extracted from **cadaver pituitaries**, and **prion contamination** caused fatal **Creutzfeldt-Jakob disease** — so it was banned in 1985. Today we use safe **recombinant rhGH** made in bacteria.




*Creutzfeldt-Jakob disease: a fatal prion brain disease — why we switched to bacterial rhGH.*

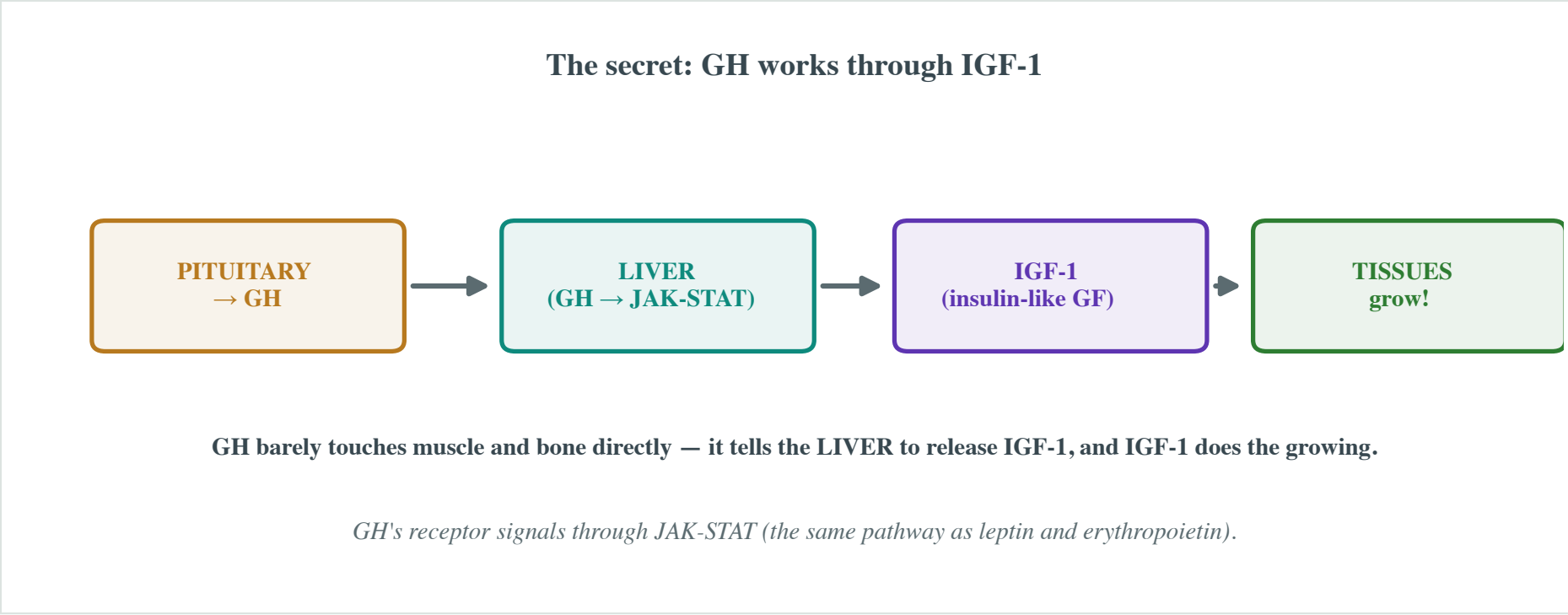
# The somatotroph's control panel

GH release is a **push-pull** system. Two signals **push**: **GHRH** from the hypothalamus (working through **cAMP/PKA**) and **ghrelin** from the gut (through **PLC/$IP_3$/$Ca^{2+}$**). Two signals **brake**: **somatostatin** (shuts off adenylyl cyclase and calcium) and **IGF-1** (turns off the GH gene). (**Dopamine** and other neurotransmitters tune the signal too.) And the output isn't steady – GH comes in **pulses**, with the biggest surge during **deep sleep**. So "you grow in your sleep" is **literally** true, once again.



# The secret: GH works through IGF-1

Here's the twist that surprises everyone: **GH barely touches your muscles and bones directly**. Instead, GH tells the **liver** to make **IGF-1 (insulin-like growth factor-1)**, and it's **IGF-1 that reaches the tissues and does the growing**. GH is the command; IGF-1 is the courier that carries it out. And the GH receptor signals through **JAK-STAT** — the very same pathway you met for **leptin** and **erythropoietin**. One relay, reused across the whole endocrine system.

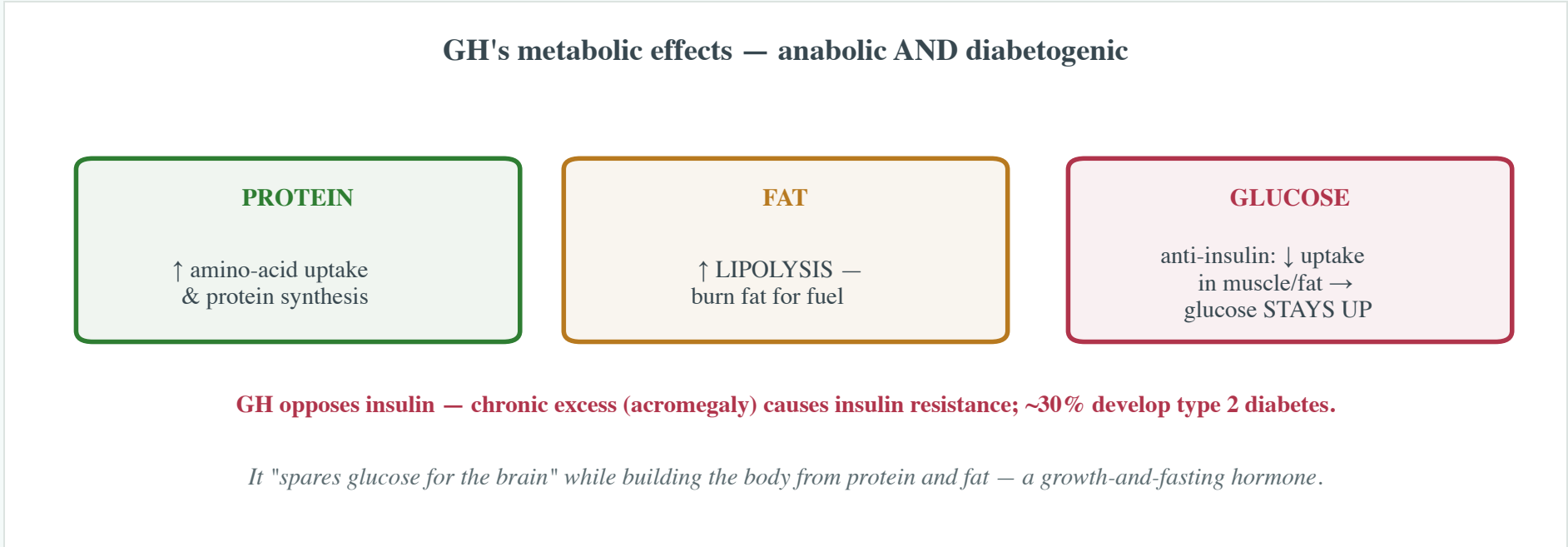


# 2 · GH's Metabolism & IGF-1 Feedback

"Growth hormone is a paradox: it's anabolic (builds muscle and bone through IGF-1) but also diabetogenic (it fights insulin and raises blood sugar). And like every axis in this course, IGF-1 closes a tidy negative-feedback loop."

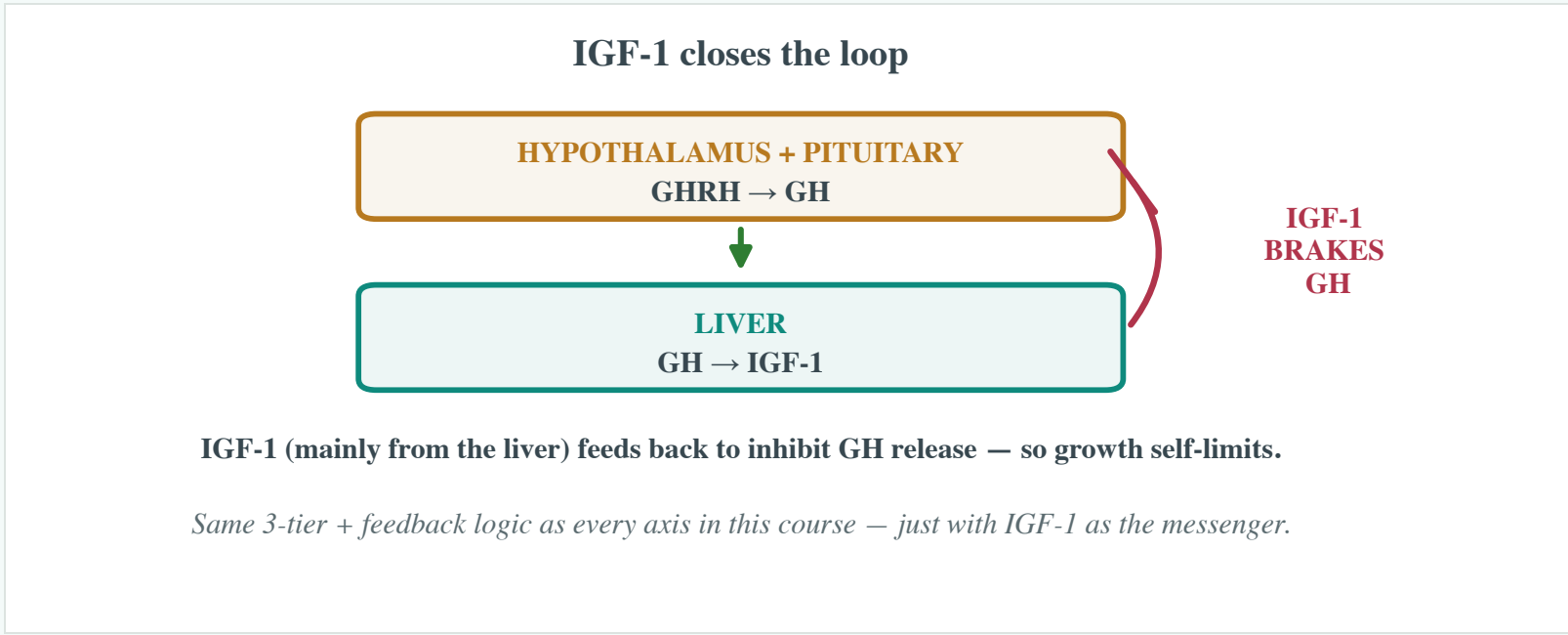
# Anabolic, but diabetogenic

GH's metabolic program has three parts, and one is a trap. **Protein**: it boosts **amino-acid uptake and protein synthesis** (with IGF-1) — building muscle and bone. **Fat**: it drives **lipolysis**, burning fat for fuel. **Glucose**: here's the catch — GH is **anti-insulin**, cutting glucose uptake in muscle and fat so **blood sugar stays up**. That "spare glucose for the brain" effect makes GH useful in fasting, but **chronically high GH causes insulin resistance** — about **30% of acromegaly patients develop type 2 diabetes**. Anabolic and diabetogenic at once.



# IGF-1 closes the loop

Growth can't run away, because it **self-limits** — through the same courier that carries it out. When GH drives the **liver** to make **IGF-1**, that IGF-1 does two jobs: it grows the tissues, **and** it **feeds back to inhibit GH release** (acting on both the hypothalamus and pituitary). So more growth signal → more IGF-1 → less GH. It's the identical **three-tier axis with negative feedback** you've seen for the thyroid, adrenal, and gonads — just with **IGF-1** as the feedback messenger.



# 3 · GH Disorders & Lifestyle

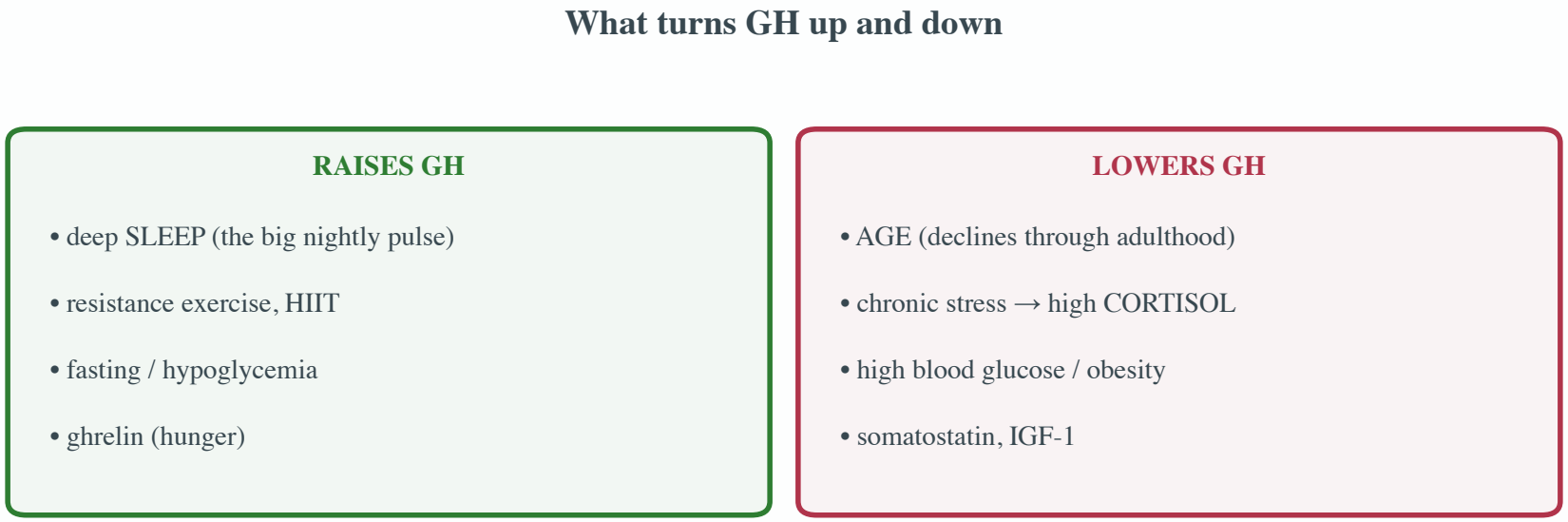
"Too little growth hormone stunts kids and drains adults; too much does very different things depending on one thing – whether your growth plates have fused yet. And day to day, GH is swayed by sleep, exercise, fasting, and stress."

# GH disorders — and why timing decides the picture

GH disease comes in three forms, and the excess ones hinge on **timing**. **Deficiency** stunts **kids** (short stature, delayed puberty) and saps **adults** (fatigue, low bone density, more fat) — treated with **recombinant rhGH**. **Excess before the growth plates fuse** → **gigantism**: excessive **height** and enlarged limbs. **Excess after they fuse** (adult) → **acromegaly**: the bones can't lengthen, so they **thicken** — enlarged **hands, feet, face**, joint pain, and organ overgrowth (usually from a **pituitary adenoma**). Same excess, opposite shape — all about **when**. Treat excess with **surgery, somatostatin analogs, or GH-receptor blockers**.

# What moves GH day to day

GH isn't fixed — it swings with how you live. It **rises** with **deep sleep** (the big nightly pulse), **resistance exercise** and **HIIT**, **fasting/hypoglycemia**, and **ghrelin**. It **falls** with **age** (it steadily declines through adulthood), **high blood glucose or obesity**, and its own brakes, **somatostatin and IGF-1**. The sneaky one is **chronic stress**: sustained **cortisol suppresses GH and IGF-1** — which is exactly why prolonged stress can **stunt growth in children**. Sleep, move, and manage stress, and your GH takes care of itself.




*Chronic stress is the sneaky one: high cortisol suppresses GH and IGF-1, stunting growth in kids.*

# Can you…?

- □ describe GH production (somatotropes) and its regulation (GHRH/ghrelin push; somatostatin/IGF-1 brake; pulsatile, sleep-linked), plus the CJD history and the IGF-1 mediator?
- □ explain that GH acts largely through liver-made IGF-1 (JAK-STAT receptor), its metabolic effects (anabolic but anti-insulin/diabetogenic), and the IGF-1 negative-feedback loop?
- □ analyze GH disorders (deficiency; gigantism vs acromegaly by growth-plate timing) and the lifestyle factors (sleep, exercise, fasting, stress/cortisol) that modulate GH?

If any box stays empty, the practice site has a drill for it.
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