

 **SOURCE NOTE:** This topic was not present in Student's uploaded personal notes. Content has been drawn from standard NGN NCLEX 2026 references including *Saunders Comprehensive Review for the NCLEX-RN (2026 ed.)*, *ATI Pharmacology Made Easy*, *Lippincott Pharmacology*, the AACE/Endocrine Society Clinical Practice Guidelines for GH Use in Adults & Children, and current FDA prescribing information for somatropin products.

ENDOCRINE • PHARMACOLOGY

Growth Hormone Replacement Therapy

Somatropin (recombinant human GH) and related agents — indications, administration, monitoring, and safety priorities across pediatric and adult populations.

High-Yield Topic

NCJMM Integrated

Peds + Adult

Black Box Warning

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DEFINITION

Overview — What & Why

- ▶ **Growth Hormone (GH/somatotropin)** is an anterior pituitary hormone that stimulates linear growth (children), maintains muscle mass and bone density, regulates fat/carbohydrate metabolism, and promotes IGF-1 production by the liver.
- ▶ **GH Replacement Therapy** uses **recombinant human growth hormone (rhGH / somatropin)** given by **subcutaneous injection** to replace deficient endogenous GH.
- ▶ **Why it matters:** Untreated childhood GH deficiency causes *short stature, delayed puberty, hypoglycemia*; adult GH deficiency causes *decreased lean mass, central obesity, dyslipidemia, low bone density, and impaired quality of life*.



Pediatric Indications

- GH deficiency (idiopathic or organic)
- Turner syndrome
- Prader-Willi syndrome
- SHOX gene deficiency
- Chronic kidney disease (pre-transplant)
- Small for gestational age (SGA) without catch-up
- Noonan syndrome
- Idiopathic short stature



Adult Indications

- Adult-onset GH deficiency (pituitary tumor, surgery, radiation, trauma)
- Childhood-onset GHD continuing into adulthood
- HIV-associated wasting / cachexia
- Short bowel syndrome (Zorbtive)

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PATHOPHYSIOLOGY

Mechanism — Hypothalamic-Pituitary-Liver Axis

STEP 1

Hypothalamus releases **GHRH** (Growth Hormone Releasing Hormone) → stimulates anterior pituitary

STEP 2

Anterior pituitary releases **GH (somatotropin)** into circulation (pulsatile, peaks at night)

STEP 3

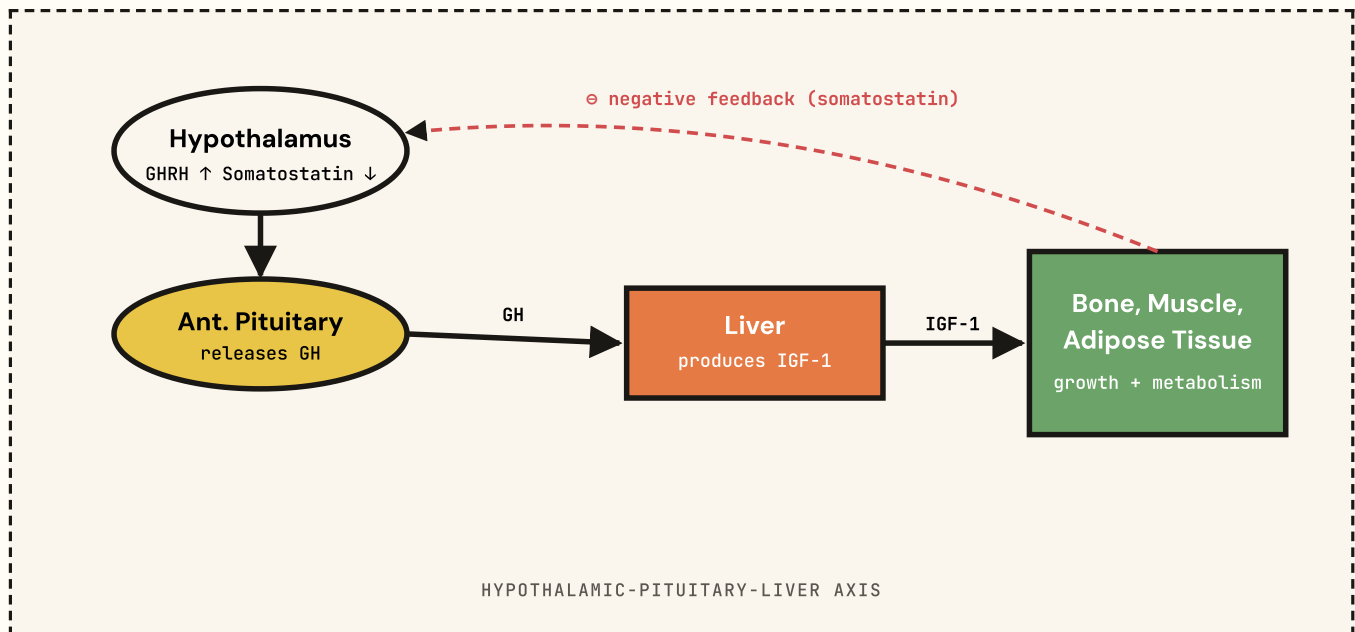
GH acts on **liver** → produces **IGF-1** (Insulin-like Growth Factor 1)

STEP 4

IGF-1 → stimulates **linear growth at epiphyseal plates** (children) + protein synthesis, lipolysis

STEP 5

Somatostatin from hypothalamus inhibits GH (negative feedback loop)



KEY: Somatotropin works *indirectly* through IGF-1 — that's why **IGF-1 levels** (not GH levels) are the primary *therapeutic monitoring lab*.

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SIGNS & SYMPTOMS

Deficiency vs. Therapy Adverse Effects



Signs of GH DEFICIENCY (pre-therapy)

CHILDREN

- Growth velocity < 4–5 cm/year
- Height < 3rd percentile / >2 SD below mean
- Delayed bone age (x-ray)
- Delayed puberty, immature facies
- Fasting hypoglycemia, ↑ central adiposity

ADULTS

- ↓ Lean body mass, ↑ visceral fat
- Fatigue, depression, ↓ QoL
- Dyslipidemia, ↑ cardiovascular risk
- ↓ Bone mineral density



Adverse Effects of THERAPY

COMMON / MILD

- Injection-site reactions (redness, lipatrophy)
- Headache
- Fluid retention → edema, arthralgia, myalgia
- Carpal tunnel syndrome

SERIOUS / RED-FLAG

- **Hyperglycemia / insulin resistance** (new-onset T2DM)
- **Intracranial hypertension** (HA, vision changes, papilledema)
- **Slipped Capital Femoral Epiphysis (SCFE)** — child with hip/knee pain, limp
- **Worsening scoliosis** during rapid growth
- **Pancreatitis** (severe abdominal pain)
- Hypothyroidism (unmasks subclinical disease)



BLACK BOX WARNING: Increased mortality in critically ill adult patients in the ICU (post-op, multiple trauma, acute respiratory failure). **Do NOT initiate** somatropin in acutely critically ill patients. Also contraindicated in **Prader-Willi with severe obesity or severe respiratory impairment** — risk of sudden death.

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NURSING PRIORITIES

ABC + Safety + Monitoring Framework

A

Airway / Breathing

- Screen for OSA in Prader-Willi *before* starting
- Monitor for new snoring, daytime sleepiness
- Hold dose & notify provider if respiratory distress develops

C

Circulation / Metabolic

- **Monitor blood glucose** (FBG, HbA1c q3–6 mo)
- Monitor for edema, weight gain, BP
- Lipid panel periodically

L

Labs & Growth

- **IGF-1 levels** (titrate dose to mid-normal range for age)
- **TSH, free T4** (every 6–12 mo)
- Bone age x-ray annually (children)
- Height/weight at every visit



Administration Priorities

- ▶ **Route:** Subcutaneous injection (most products) — abdomen, thigh, upper arm, buttock. **Rotate sites** to prevent lipoatrophy.
- ▶ **Timing:** Give **at bedtime** to mimic the natural nocturnal GH pulse.
- ▶ **Frequency:** Daily SubQ for most products; **long-acting somatrogon (Ngenla)** and **lonapegsomatropin (Skytrofa)** are *once-weekly*.
- ▶ **Storage:** Refrigerate (36–46°F / 2–8°C). **Do NOT freeze. Do NOT shake** — gently swirl to reconstitute.
- ▶ **Inspect:** Solution should be clear and colorless. Discard if cloudy or discolored.
- ▶ **Once reconstituted:** Use within manufacturer-specified window (typically 14–28 days refrigerated, product-dependent).
- ▶ **Discard sharps** in puncture-resistant container; teach safe disposal.

STOP

STOP THERAPY when: Epiphyses close (children — confirm with bone age x-ray); new or active malignancy; acute critical illness; severe respiratory impairment in Prader-Willi; diabetic retinopathy (relative).

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PHARMACOLOGY

Drug Comparison — Somatropin Products & Related Agents

DRUG / BRAND	CLASS	ROUTE / FREQUENCY	KEY INDICATIONS	KEY CONSIDERATIONS
Somatropin Genotropin Humatrope Norditropin Nutropin Saizen Omnitrope	Recombinant hGH	SubQ daily , bedtime	Peds GHD, Turner, PWS, SHOX, SGA, CKD, ISS; Adult GHD	Refrigerate, don't shake; monitor IGF-1, glucose, TSH; rotate sites
Somatrogon Ngenla	Long-acting hGH	SubQ once weekly	Pediatric GHD	Same day each week; improves adherence; same AE profile
Lonapegsomatropin Skytrofa	Long-acting prodrug hGH	SubQ once weekly	Pediatric GHD (≥1 yr, ≥11.5 kg)	Cartridge auto-injector; check IGF-1 mid-week trough
Somapacitan Sogroya	Long-acting hGH analog	SubQ once weekly	Adult & pediatric GHD	Albumin-binding extends half-life; same day weekly
Mecasermin Increlex	Recombinant IGF-1	SubQ twice daily with meals	Severe primary IGF-1 deficiency (when GH ineffective)	🚫 Hypoglycemia risk — must give with food; monitor BG
Tesamorelin Egrifta	GHRH analog	SubQ daily	HIV-associated lipodystrophy	Reduces visceral adiposity; not for GH replacement

⚠️ CONTRAINDICATIONS

- Active malignancy
- **Closed epiphyses** (for growth indication)
- Acute critical illness (post-op, trauma, ARF)
- Prader-Willi + severe obesity or sleep apnea
- Active proliferative diabetic retinopathy
- Hypersensitivity to benzyl alcohol (in some preps — caution in neonates)

⚠️ DRUG INTERACTIONS

- **Insulin / oral hypoglycemics:** may need ↑ dose (GH ↑ insulin resistance)
- **Glucocorticoids:** high doses inhibit growth-promoting effect
- **Oral estrogens:** ↓ IGF-1 response — may need higher GH dose in women on oral estrogen
- **Cytochrome P450 substrates:** GH may alter clearance — monitor

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TEST TRAPS



NCLEX Wrong vs. Right Thinking

✗ WRONG

"Shake the vial vigorously to fully dissolve the powder before injecting."

→

✓ RIGHT

Gently swirl — never shake. Shaking denatures the GH protein and inactivates the medication.

✗ WRONG

"Give somatropin in the morning so the child has energy for the day."

→

✓ RIGHT

Give **at bedtime** to mimic the natural nocturnal GH surge.

✗ WRONG

"Monitor serum GH levels to titrate the dose."

→

✓ RIGHT

Monitor **IGF-1 levels** — GH itself is pulsatile and unreliable; IGF-1 reflects average GH activity.

✗ WRONG

"A child on GH therapy reports hip and knee pain — give acetaminophen and reassess in 24 hours."

→

✓ RIGHT

Notify the provider immediately — rule out **SCFE (slipped capital femoral epiphysis)**, a surgical emergency.

✗ WRONG

"Continue somatropin in the ICU patient post-cardiac surgery — it will help wound healing."

→

✓ RIGHT

Hold somatropin in acutely critically ill patients — **black box warning** for increased mortality.

✗ WRONG

"Give insulin doses as usual once GH therapy starts."

→

✓ RIGHT

Anticipate increased insulin requirements — GH causes insulin resistance and hyperglycemia.

✗ WRONG

"Continue GH past the closure of epiphyses to keep gaining height."

→

✓ RIGHT

Once epiphyses are **closed**, no further linear growth is possible — **discontinue for height indication**. (Adults with GHD continue at lower replacement doses for metabolic reasons.)

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EDUCATION

Patient & Family Teaching



Injection Technique

- Wash hands; clean site with alcohol
- **Rotate injection sites** (abdomen, thigh, upper arm, buttock)
- Pinch skin, insert at **45–90°** per device
- Gently swirl — **never shake**
- Inspect solution: clear, colorless; discard if cloudy
- Use prefilled pen/auto-injector if available



Storage

- **Refrigerate** 36–46°F (2–8°C)
- **Do NOT freeze** — discard if frozen
- Protect from light
- Once reconstituted: use within product-specified window
- Travel: insulated cooler with ice pack (not touching vial)



Daily Routine

- Give at **same time each day, preferably bedtime**
- If dose missed: give as soon as remembered same day; **skip if next dose is <8 hr away** — do not double up
- Keep a medication/growth log
- Encourage **balanced nutrition**, adequate protein, sleep, exercise



When to Call the Provider

- Severe or persistent **headache, vision changes, vomiting** (↑ ICP)
- **Hip, knee, or thigh pain** or new limp (SCFE)
- Increased thirst, urination, blurred vision (hyperglycemia)
- New back curvature (scoliosis progression)
- Persistent injection-site lump or skin changes
- Severe abdominal pain (pancreatitis)



Realistic Expectations: Growth response is gradual — *do not expect dramatic height changes overnight*. Typical first-year growth is ~8–10 cm in children with GHD; subsequent years slow to ~5–7 cm/year. Routine endocrine follow-up is essential.

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MNEMONICS

Quick Recall Aids

GROWTH

- G** lucose — monitor (insulin resistance)
- R**otate injection sites
- O**nce daily at bedtime (or weekly long-acting)
- W**arm to room temp; never freeze
- T**hyroid (TSH) + IGF-1 — monitor labs
- H**ip pain = STOP, suspect SCFE

SHAKE NOT

- S**ubQ route
- H**eadache → r/o ↑ ICP
- A**t bedtime (mimics nocturnal pulse)
- K**eep refrigerated
- E**piphyses closed → STOP
- N**ever in critically ill (BBW)
- O**besese PWS → contraindicated
- T**itrate by IGF-1, NOT GH levels

🔑 Pattern Recognition Quick Hits

- **"Don't shake — swirl"** applies to ALL protein/biologic injections: GH, insulin suspensions, monoclonals.
- **"At bedtime"** mimics the body's natural nocturnal GH surge.
- **"Closed epiphyses = no more height"** — confirmed by hand/wrist bone age x-ray.
- **"GH ↑ blood sugar"** — opposite of insulin; expect ↑ insulin needs in diabetics.
- **"Hip/knee pain in a growing child on GH = call the provider STAT"** (SCFE is the #1 NCLEX-classic complication).

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CLINICAL JUDGMENT

NCJMM 6-Step Walkthrough

SCENARIO:

An 11-year-old child diagnosed with idiopathic GH deficiency has been receiving daily subcutaneous somatropin (Norditropin) 0.3 mg/kg/week divided daily for 8 months. The parent calls the clinic and reports: *"He's been complaining about his left hip and knee for the past 4 days, and today he started limping. He says it hurts more when he walks. He hasn't fallen or injured himself."* Vital signs are stable. He has gained 6 cm in height since starting therapy.

STEP 1 • RECOGNIZE CUES

What clinical findings are relevant?

Critical cues: Child on GH therapy × 8 months · new **hip + knee pain** · **limp** · pain worsens with weight-bearing · **no trauma** · 6 cm growth (rapid linear growth on GH). **Knee pain in a child can be referred from the hip** — classic red-herring.

STEP 2 • ANALYZE CUES

What do these cues mean?

The combination of **GH therapy + rapid growth + atraumatic hip/knee pain + limp** in a school-age child strongly suggests **Slipped Capital Femoral Epiphysis (SCFE)**. GH accelerates linear growth, which stresses the proximal femoral growth plate. SCFE is a **known adverse effect** of GH therapy. Other differentials (transient synovitis, septic arthritis, fracture) are less likely given the GH context and absence of fever/trauma.

STEP 3 • PRIORITIZE HYPOTHESES

Most likely → least likely?

1. **SCFE (highest priority — orthopedic emergency)**
2. Transient (toxic) synovitis
3. Septic arthritis (lower without fever, but cannot fully exclude)
4. Legg-Calvé-Perthes disease
5. Musculoskeletal strain

STEP 4 • GENERATE SOLUTIONS

What actions are appropriate?

- **Instruct parent: bring child in immediately** (or to ED) — do NOT bear weight on the affected leg
- Notify the endocrinologist and orthopedic provider
- Anticipate **hip x-ray (AP + frog-leg lateral)**
- **Hold the next dose** of somatropin pending evaluation
- Keep child NPO in case surgical fixation is needed
- Reassure family — this is a known complication, not their fault

STEP 5 • TAKE ACTION

Highest-priority intervention RIGHT NOW

Direct the parent to bring the child to the ED immediately and keep him NON-WEIGHT-BEARING. Activate the provider/endocrinologist. Document the call, the cues reported, instructions given, and time of provider notification.

STEP 6 • EVALUATE OUTCOMES

What indicates resolution?

- Imaging confirms or rules out SCFE
- If SCFE confirmed: **in situ screw fixation** performed; child stabilized post-op
- Somatropin is **held until cleared by ortho + endo**
- Pain resolves; gait normalizes after recovery
- Family verbalizes understanding of warning signs and the need to **report any future hip/knee/thigh pain immediately**