NCLEX-RN PHARMACOLOGY INFOGRAPHIC

HUMAN GROWTH HORMONE

Somatropin (rhGH)

Genotropin • Humatrope • Norditropin • Nutropin • Omnitrope • Saizen

CLASS: Anterior Pituitary Hormone / Recombinant Human Growth Hormone | **SYSTEM:** Endocrine

⚠ **HIGH-ALERT ENDOCRINE DRUG • BLACK BOX WARNING: ACUTE CRITICAL ILLNESS** ⚠

1. DRUG OVERVIEW — WHY WE GIVE IT

PEDIATRIC USES (open growth plates):

- Growth hormone deficiency (GHD) → short stature
- Turner syndrome — girls with missing/partial X chromosome
- Prader-Willi syndrome (NOT if severely obese or severe sleep apnea)
- Chronic kidney disease (CKD) growth failure
- SHOX gene deficiency; Noonan syndrome
- Idiopathic short stature (ISS); SGA without catch-up growth

ADULT USES:

- Adult-onset GH deficiency (pituitary tumor, surgery, radiation)
- HIV-associated wasting / cachexia
- Short bowel syndrome (Zorbtive)

✗ NOT FOR:

- Athletic enhancement, anti-aging, or cosmetic height gain — not FDA approved
- Children with CLOSED epiphyses (bone age > ~14 girls / ~16 boys)

2. MECHANISM OF ACTION

Somatropin (exogenous GH) mimics endogenous anterior pituitary GH

- Binds GH receptors on target tissues (liver, bone, muscle, fat)
- → Liver releases IGF-1 (Somatomedin C) — the main growth mediator
- → IGF-1 stimulates epiphyseal plate chondrocytes = linear bone growth
- → Promotes protein synthesis (anabolic) = lean muscle mass
- → Stimulates lipolysis = fat breakdown & ↓ adipose tissue
- → Gluconeogenesis ↑ + insulin resistance = ↑ blood glucose
- → Sodium & water retention = mild edema

KEY PATHWAY:
Somatropin → GH receptor → Liver → IGF-1 → Bone / Muscle / ↑ Glucose / ↓ Fat

3. THERAPEUTIC EFFECTS — IS IT WORKING?

PEDIATRIC:

- ↑ Linear growth velocity (measure height every 3–6 months)
- Expect 8–10 cm/year in year 1; slows thereafter
- Advancing bone age on X-ray (appropriately, not too fast)
- IGF-1 rising INTO normal range for age (not above)

ADULT:

- ↑ Lean body mass, ↓ visceral fat
- Improved energy, mood, exercise tolerance
- Normalized IGF-1 level
- Improved bone mineral density over 12+ months
- Normalized lipid profile (↓ LDL)

4. SIDE EFFECTS & ADVERSE REACTIONS

COMMON (usually dose-related):

- Injection site reactions, lipoatrophy
- Headache (mild)
- Arthralgia / myalgia / joint stiffness
- Peripheral edema, fluid retention
- Nausea, transient

SERIOUS / LIFE-THREATENING:

- **Acute critical illness mortality** (BLACK BOX) — ↑ death in ICU patients after open-heart/abdominal surgery, trauma, or respiratory failure
- **Intracranial hypertension** (pseudotumor cerebri) → severe headache, vision changes, N/V, papilledema
- **Slipped Capital Femoral Epiphysis (SCFE)** → limping child, hip or KNEE pain — STOP drug, notify provider
- **Hyperglycemia / new-onset diabetes** — insulin resistance; may unmask T2DM
- **Fatal respiratory events in Prader-Willi** with severe obesity or untreated sleep apnea
- **Scoliosis progression** in rapidly growing children
- **Pancreatitis** (rare) → severe abdominal pain, ↑ lipase/amylase
- **Hypothyroidism** — masks or unmasks, may need levothyroxine
- **Second neoplasm** in childhood cancer survivors; possible tumor growth
- **Acromegaly** (with overdose/abuse) — enlarged hands, feet, jaw, coarse features
- **Carpal tunnel syndrome** (adults) — hand numbness/tingling

5. PRIORITY NURSING CONSIDERATIONS

→ ASSESS:

- Baseline height, weight, growth velocity (peds)
- Baseline bone age X-ray (left wrist)
- Baseline glucose, IGF-1, TSH/T4, cortisol
- Screen for scoliosis, gait, hip/knee pain at each visit
- Vision changes, fundoscopy for papilledema

→ MONITOR:

- Height q3–6 months; bone age yearly
- IGF-1, HbA1c, fasting glucose q6–12 months
- TSH, free T4 at 6–12 months (can unmask hypothyroidism)
- Fundoscopic exam if headache/vision changes

→ HOLD / STOP (notify provider!):

- **Acute critical illness** — post cardiac/abdominal surgery, multiple trauma, acute respiratory failure (BLACK BOX)
- **Active malignancy** or evidence of tumor growth/recurrence
- **Closed epiphyses** in peds (no further linear growth possible)
- **Severe obesity or sleep apnea** in Prader-Willi patients
- **Severe / proliferative diabetic retinopathy**
- **Signs of pseudotumor cerebri** (severe HA, vision change, papilledema)
- **Limping child / hip-knee pain** → possible SCFE

→ DRUG INTERACTIONS:

- **Glucocorticoids:** BLUNT growth response — minimize dose
- **Insulin / oral hypoglycemics:** may need ↑ dose (GH = hyperglycemia)
- **Oral estrogens:** may require higher GH dose
- **CYP450 substrates:** GH alters clearance — monitor carefully

6. LABS & DIAGNOSTICS

- **IGF-1 (Somatomedin C):** PRIMARY efficacy & safety marker — keep mid-normal for age; ↑ above normal = overdose risk
- **Fasting glucose & HbA1c:** watch for hyperglycemia; HbA1c > 6.5% = concern
- **TSH & free T4:** GH can unmask central hypothyroidism
- **Cortisol (AM):** in panhypopituitarism — must treat cortisol deficiency FIRST
- **Bone age X-ray (left wrist):** determines remaining growth potential
- **Lipid panel:** monitor cholesterol improvement
- **GH stim test (baseline dx):** insulin, arginine, clonidine, or glucagon stim

⚠ CRITICAL VALUES TO KNOW:

- IGF-1 above normal for age → reduce GH dose (acromegaly risk)
- Fasting glucose > 126 mg/dL or random > 200 mg/dL → dx diabetes
- HbA1c ≥ 6.5% → diabetes
- TSH > 4.5 with low free T4 → central hypothyroidism

7. ADMINISTRATION & SAFETY

ROUTE & TIMING:

- SUBCUTANEOUS injection (most common) — some IM formulations
- Given at BEDTIME to mimic natural nocturnal pulsatile release
- Daily injection; some long-acting weekly formulations (Sogroya, Skytrofa, Ngenla)

- Dose is weight-based (mg/kg or mg/kg/week) — recalculate with growth

STORAGE & HANDLING:

- REFRIGERATE (36–46°F / 2–8°C) — do NOT freeze
- Gently SWIRL to mix reconstituted vials — do NOT shake (protein denaturation)
- Protect from light
- Use within 14–28 days after reconstitution (varies by brand)
- Discard if cloudy, discolored, or contains particulate

INJECTION TECHNIQUE:

- ROTATE sites: abdomen, thigh, upper arm, buttocks — prevent lipoatrophy
- Use short subcut needle; pinch skin for thin patients
- Never share pens or needles (bloodborne pathogen risk)
- Safe needle disposal in sharps container

8. PATIENT / FAMILY EDUCATION

MUST TEACH:

- Growth takes YEARS — adherence to daily injections is critical
- Proper SC injection technique, rotation, storage
- Give at bedtime to match natural rhythm
- Keep a growth chart / log injections
- Monitor blood glucose if diabetic or at risk
- Regular follow-up with endocrinology + bone age x-rays

📞 CALL PROVIDER / GO TO ER IF:

- **Severe headache + vision changes + vomiting** → intracranial hypertension
- **Child limps, hip or knee pain** → SCFE emergency
- **Excessive thirst, urination, fatigue** → new-onset diabetes
- **Severe abdominal pain** → pancreatitis
- **Numbness/tingling in hands** → carpal tunnel (adults)
- **New or worsening back curvature** → scoliosis check

DO NOT:

- Skip doses or "catch up" by doubling
- Share pens/needles/cartridges
- Freeze medication or use if cloudy
- Shake vial — swirl gently
- Use for athletic/cosmetic purposes (illegal & dangerous)

9. NCLEX TEST TRAPS ⚠

- **TRAP:** "Give GH to short teen with closed growth plates" → WRONG. Bone age must confirm OPEN epiphyses.
- **TRAP:** Confusing anterior vs posterior pituitary → GH = ANTERIOR pituitary. ADH/oxytocin = POSTERIOR.
- **TRAP:** SomatroPIN (GROWS) vs SomatoSTATIN (STOPS GH) vs Octreotide (treats acromegaly) — do NOT mix these up.
- **TRAP:** GH causes HYPERglycemia, not hypoglycemia — answers saying "monitor for hypoglycemia" are distractors.

- **TRAP:** Post-op cardiac patient on GH → HOLD immediately (black-box critical-illness mortality).
- **TRAP:** Prader-Willi child who is obese or has sleep apnea → NOT a candidate; fatal respiratory risk.
- **TRAP:** Child on GH limping → the question wants SCFE assessment, NOT "give Tylenol."
- **TRAP:** "Best indicator GH is working in a 9-year-old" = GROWTH VELOCITY (cm/year), not just IGF-1 alone.
- **TRAP:** "Shake the vial" = WRONG. SWIRL gently.
- **TRAP:** Glucocorticoids + GH → steroids BLUNT growth response (taper if possible).
- **TRAP:** Headache + vomiting + vision change in child on GH = intracranial hypertension (pseudotumor cerebri), PRIORITY.
- **PRIORITY ORDER:** Airway (Prader-Willi respiratory) > Neuro (↑ ICP / pseudotumor) > Circulation (hyperglycemia DKA) > Bone (SCFE).
- **NOT PRIORITY:** Mild injection site reaction or transient arthralgia — don't pick as "most concerning."

🟩 10. MEMORY BOOSTERS & MNEMONICS

🧠 "G-R-O-W" — side effects of GH:

- G — Glucose rises (hyperglycemia, insulin resistance)
- R — Retention of sodium & water (edema)
- O — Only works if epiphyses Open (peds linear growth)
- W — Watch for vision/headache (pseudotumor cerebri) + Weakness in hip (SCFE)

🧠 NAME PATTERNS:

- **SomatroPIN** = "Pins push GROWTH" — agonist (gives GH)
- **SomatoSTATIN** = "STATIC / STOPS growth" — inhibits GH release
- **Octreotide / Lanreotide** = somatostatin analogs → treat ACROMEGALY (opposite of GH)
- **Pegvisomant** = GH-receptor ANTAGONIST → acromegaly
- **Mecasermin (Increlex)** = recombinant IGF-1 for severe primary IGF-1 deficiency

🧠 PATTERN: "GH Goes HIGH"

- Height goes high, Glucose goes high, IGF-1 goes high
- Intracranial pressure can go high (pseudotumor)
- Mortality goes high in acute critical illness

🧠 "LIMP = STOP"

- Any child on GH who limps or complains of hip/knee pain → hold drug, notify provider, assess for SCFE

🧠 BEDTIME INJECTION RULE

- Mirrors natural pulsatile GH release during deep sleep (slow-wave / stage 3 NREM)

🚨 ★. CLINICAL JUDGMENT SNAPSHOT (NCJMM)

THE 3 QUESTIONS THE NCLEX WILL TEST

1️⃣ #1 PRIORITY RISK:

- Increased MORTALITY in acute critical illness (BLACK BOX) — post-op cardiac/abdominal, trauma, acute respiratory failure. HOLD drug.
- Close runner-up: intracranial hypertension (pseudotumor cerebri) and SCFE in children.

2 WHAT HARMS THE PATIENT FIRST?

- Hyperglycemia (earliest & most common metabolic harm)
- Fluid retention → edema, headache
- ↑ Intracranial pressure → vision loss if missed
- In Prader-Willi: fatal respiratory compromise from airway obstruction

3 FIRST NURSING ACTION:

- **ASSESS FIRST** → neuro (headache, vision, papilledema), gait (limp), glucose, respiratory status (Prader-Willi).
- **HOLD THE DOSE** if any red-flag sign is present.
- **NOTIFY PROVIDER** — do not give next scheduled dose.
- **DOCUMENT** — objective findings, time of onset, interventions.
- **EDUCATE** — reinforce when to seek emergency care.

NCJMM: Recognize Cues → Analyze Cues → Prioritize Hypotheses → Generate Solutions → Take Action → Evaluate

💊 +. MOST-TESTED DRUGS IN THIS CLASS & KEY DIFFERENCES

DRUG	CLASS	USE	KEY POINT
Somatropin	rhGH agonist	GH deficiency, Turner, PWS, SBS, HIV wasting	Standard rhGH — SC daily at bedtime
Somatrogon (Ngenla)	Long-acting rhGH	Pediatric GHD	WEEKLY SC injection — better adherence
Somapacitan (Sogroya)	Long-acting rhGH	Adult & peds GHD	WEEKLY SC injection
Lonapegsomatropin (Skytrofa)	PEGylated rhGH	Pediatric GHD	WEEKLY SC injection
Mecasermin (Increlex)	Recombinant IGF-1	Severe primary IGF-1 deficiency	Risk of HYPOGLYCEMIA — give with meal
Octreotide / Lanreotide	Somatostatin analog	Acromegaly, carcinoid	OPPOSITE of GH — inhibits release
Pegvisomant (Somavert)	GH receptor antagonist	Acromegaly	Blocks GH effect — daily SC