Anterior pituitary hormones

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Pituitary Gland

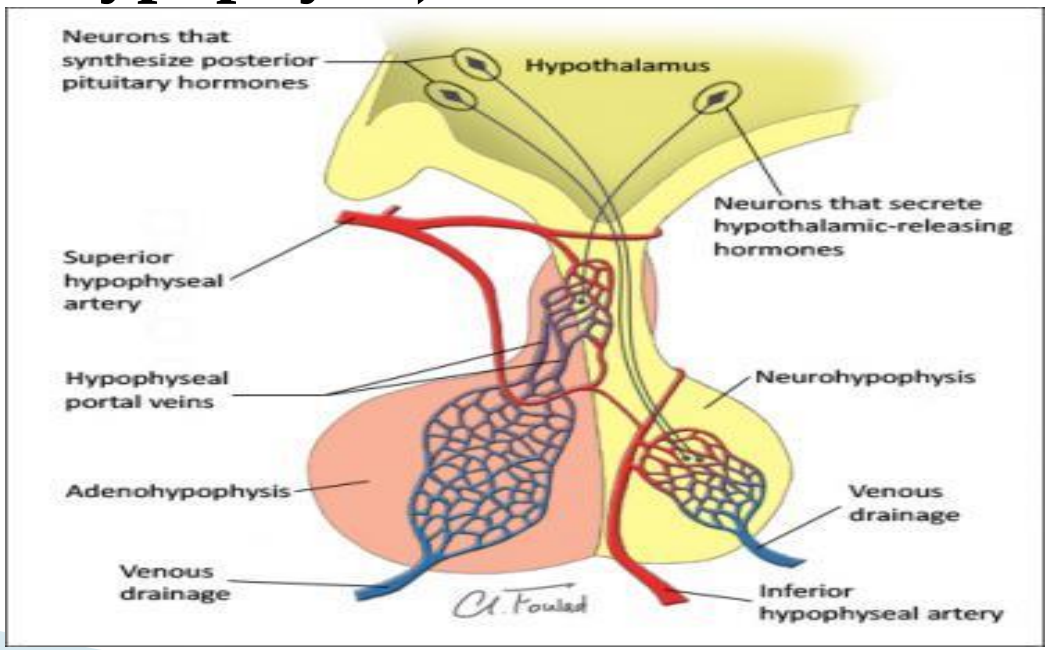
Pituitary gland is also known as the **hypophysis .**

Small gland with diameter of 1cm and

weight of 0.5 to 1gm.

Anterior pituitary **(Adeno hypophysis)**

Posterior Pituitary **(Neuro hypophysis)**

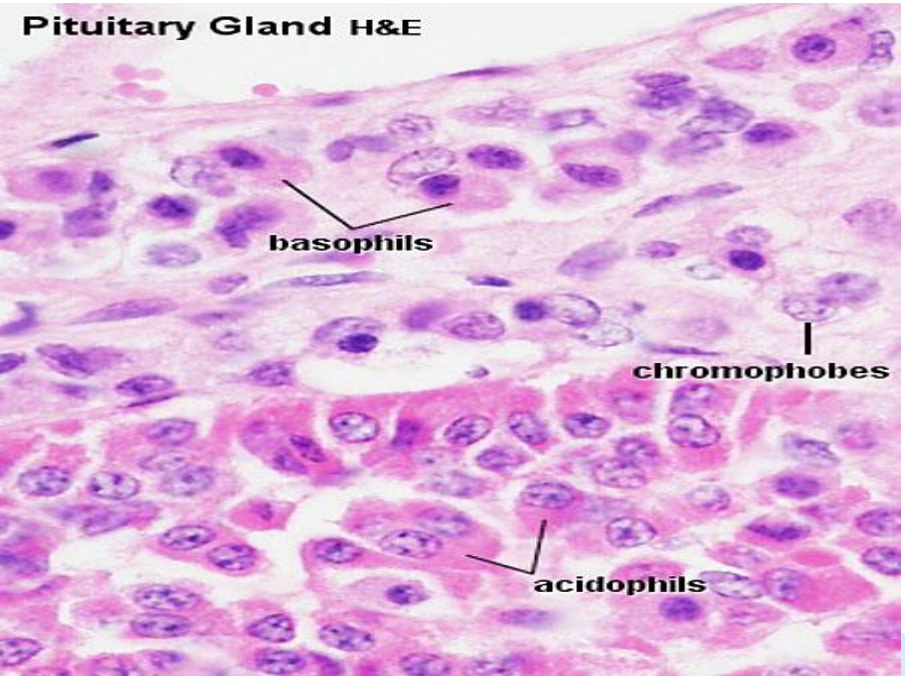


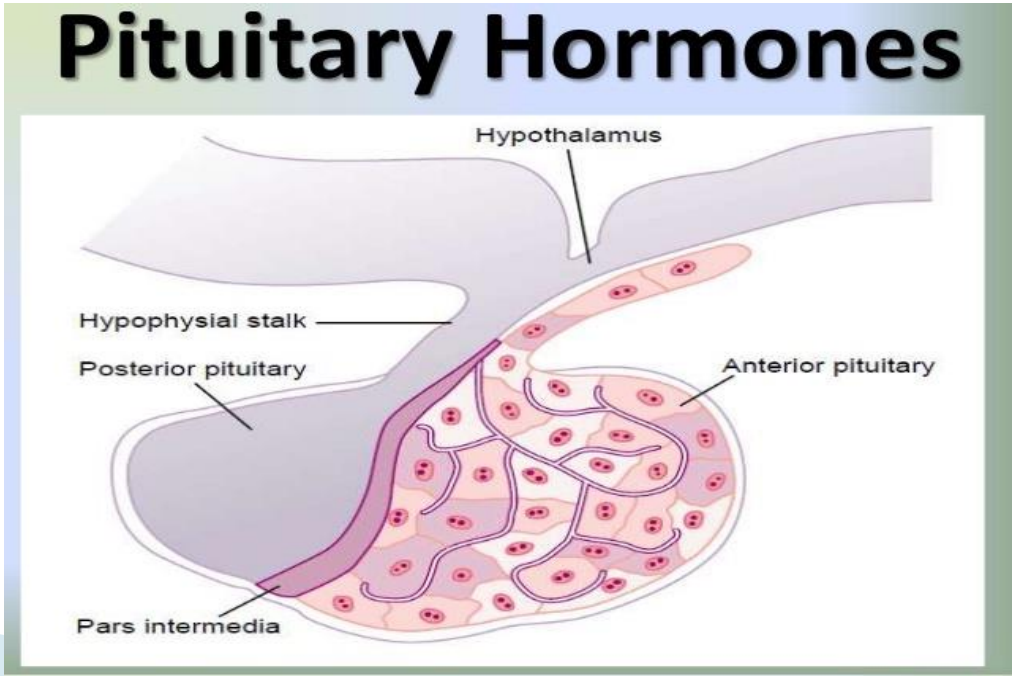
Anterior pituitary cytology

- Cells of anterior pituitary are classified as
- Chromophobes (poorly stained)
- Chromophils (well stained)

Chromophils further classified

- Acidophil (stain with acid dyes)
- Basophil (stain with basic dyes)





Anterior pituitary cytology

Using immuno cyto chemical stain for particular hormone

Acidophils can be divided into two sub groups

- Somatotrophs----------produce Growth hormone
- Mamotrophs ----------produce Prolactin

The basophils can be divided into three groups

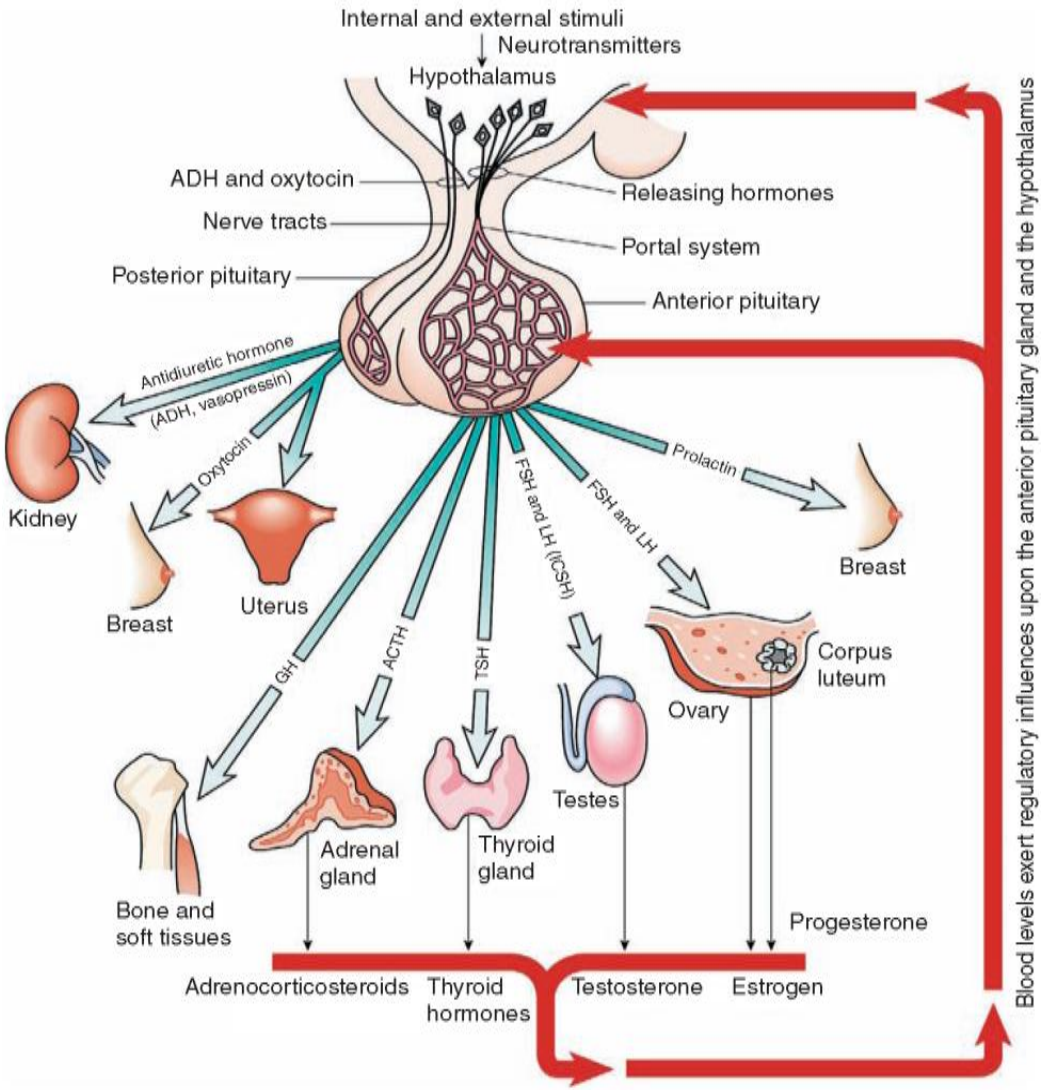
- The thyrotrophs producing TSH ,
- The gonadotrophs producing LH and FSH.
- corticotrophs producing ACTH .

Control of anterior pituitary function

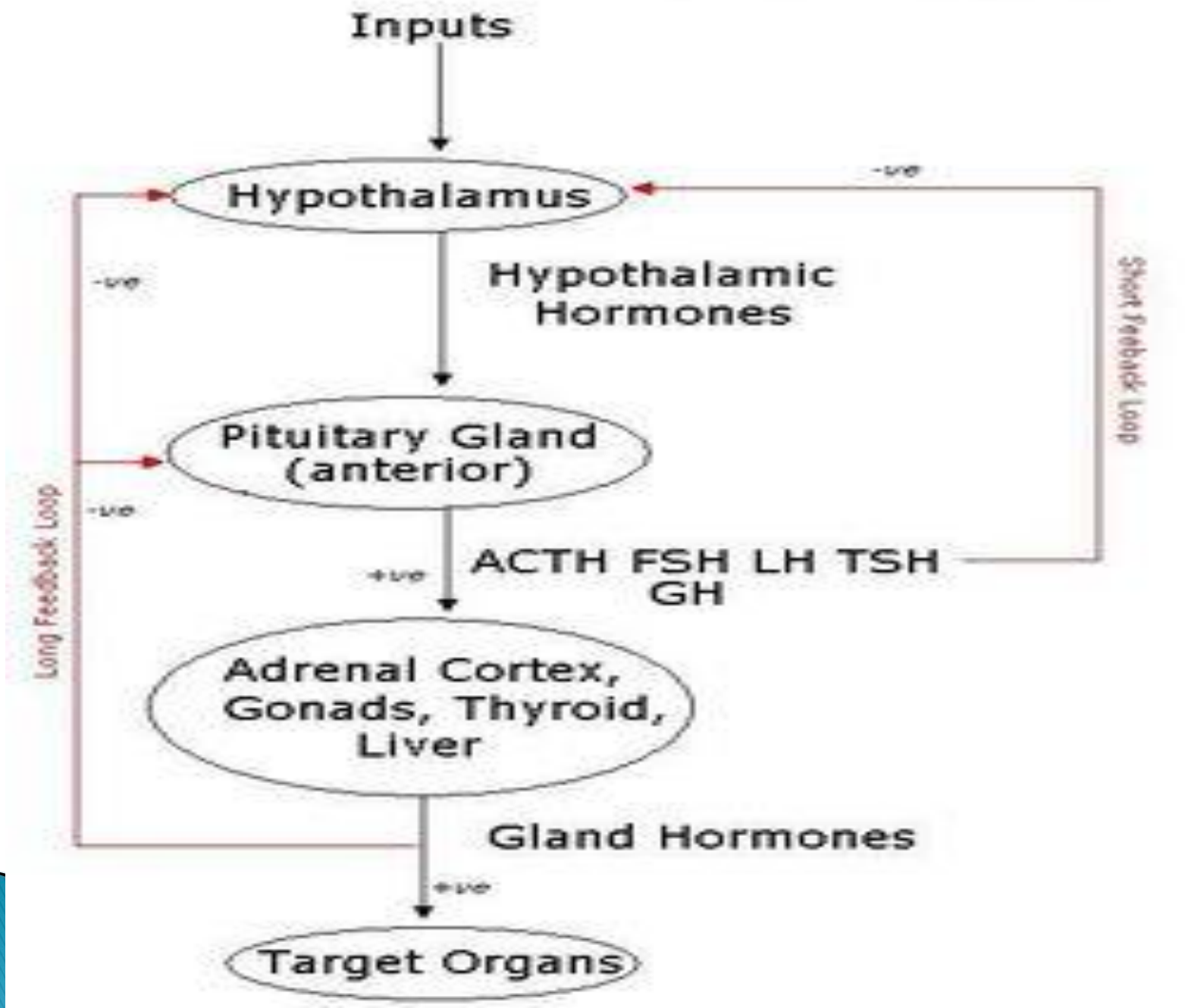
- Nervous control
- (Hypothalmic releasing factors)

The hypothalamic hormones either stimulate or inhibit the secretion of specific hormones from anterior pituitary.

The release of Hypothalamic hormones is generally pulsatile and they have short half lives.



- Hormonal control



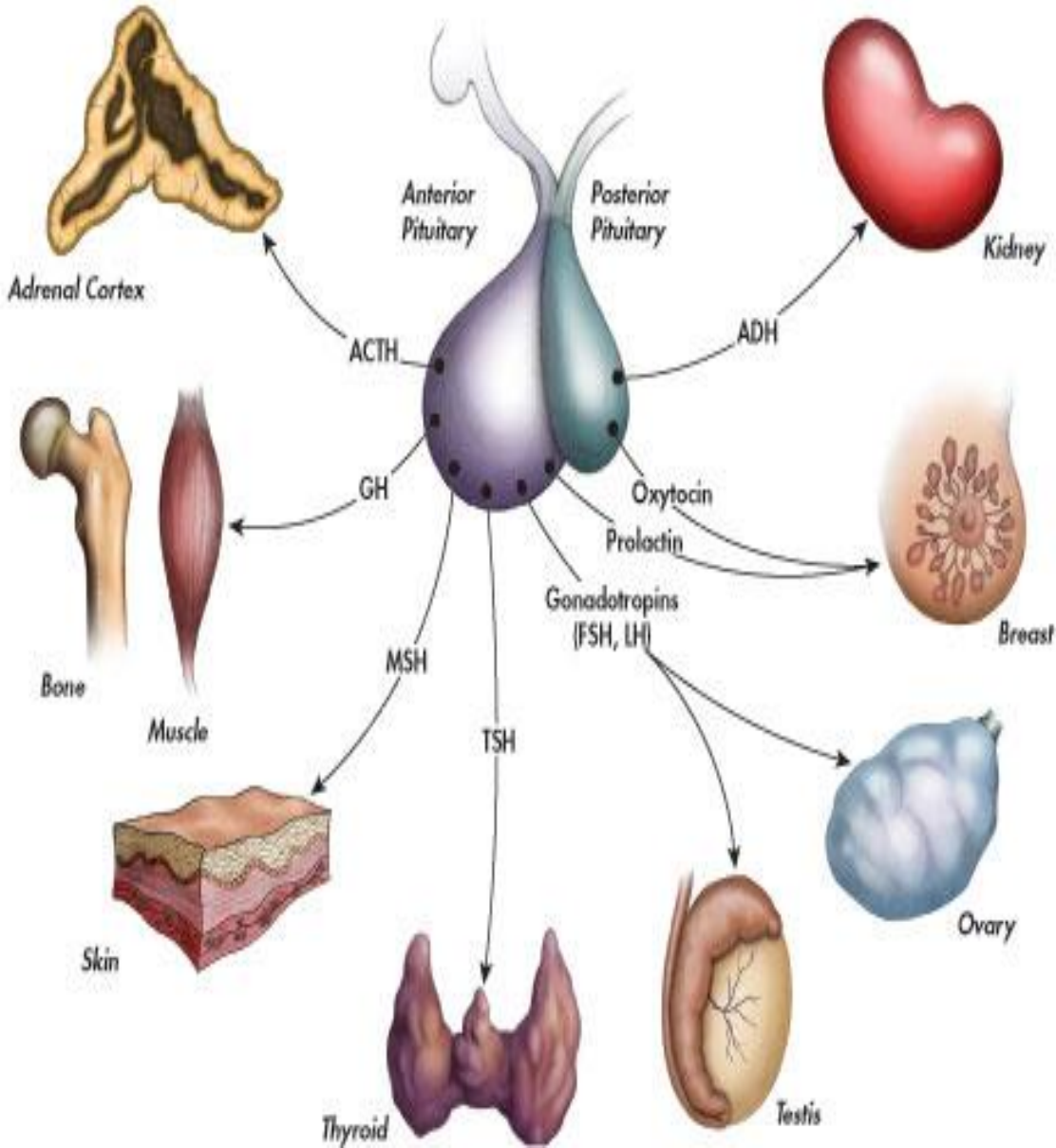
Pituitary Gland hormones

Growth hormones and Pituitary tropic hormones

Tropic hormone is one which influences the activities of other endocrine glands.

Homones of Pituitary Gland

- GH
- TSH
- ACTH
- FSH
- LH
- Prolactin
- ADH
- Oxytocin



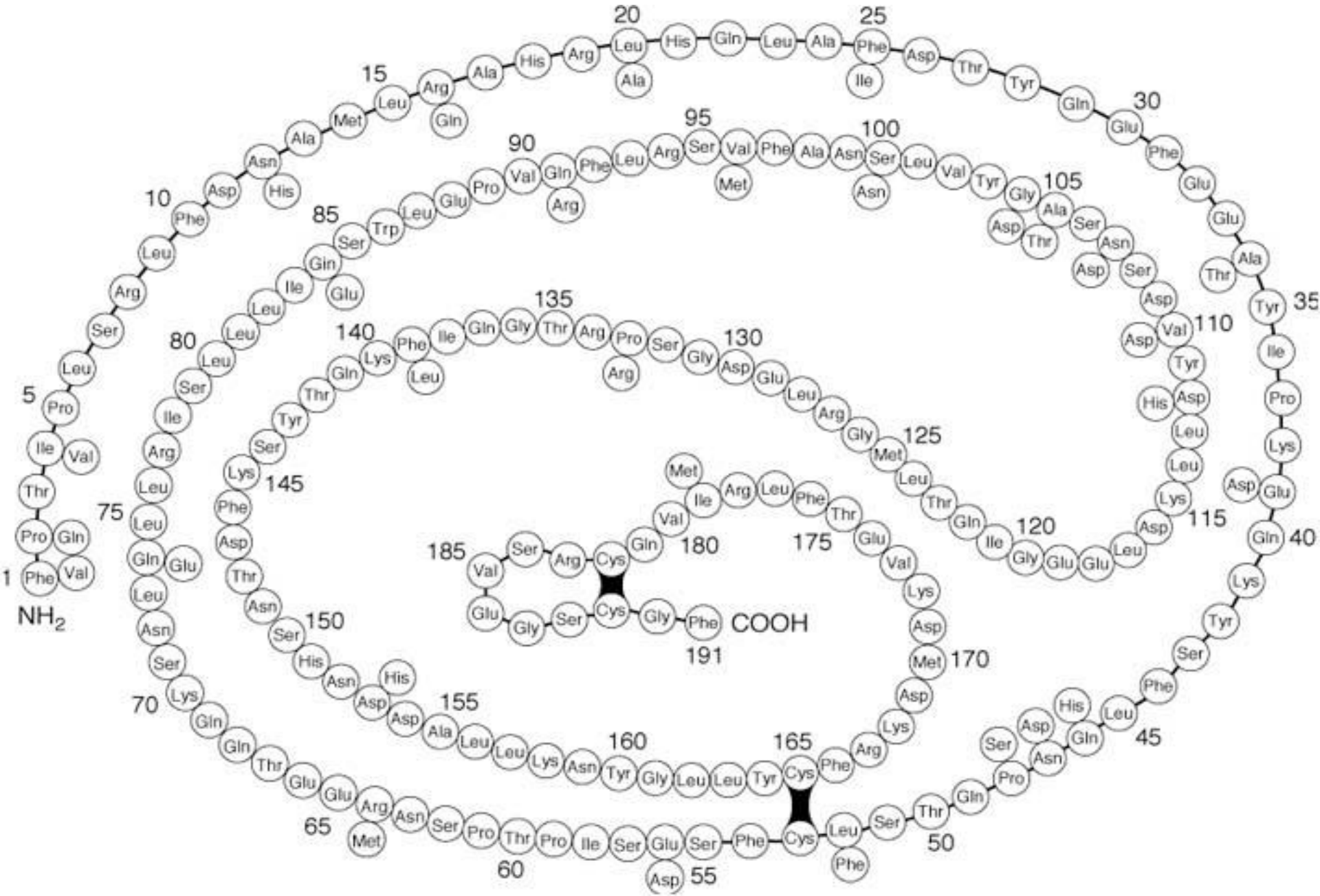
GROWTH HORMONE

- **SOURCE OF SECRETION:**

  GH is secreted by the acidophils of anterior Pituitary, which are also known as Somatotrophs.

- **CHEMISTRY OF GH:**
- **GH** is protein in nature having a single polypeptide chain with 191 Amino Acids.
- Its molecular Weight is 21,500 dalton.
- Two disulfide bridges between adjacent cysteine residues.

Growth hormone

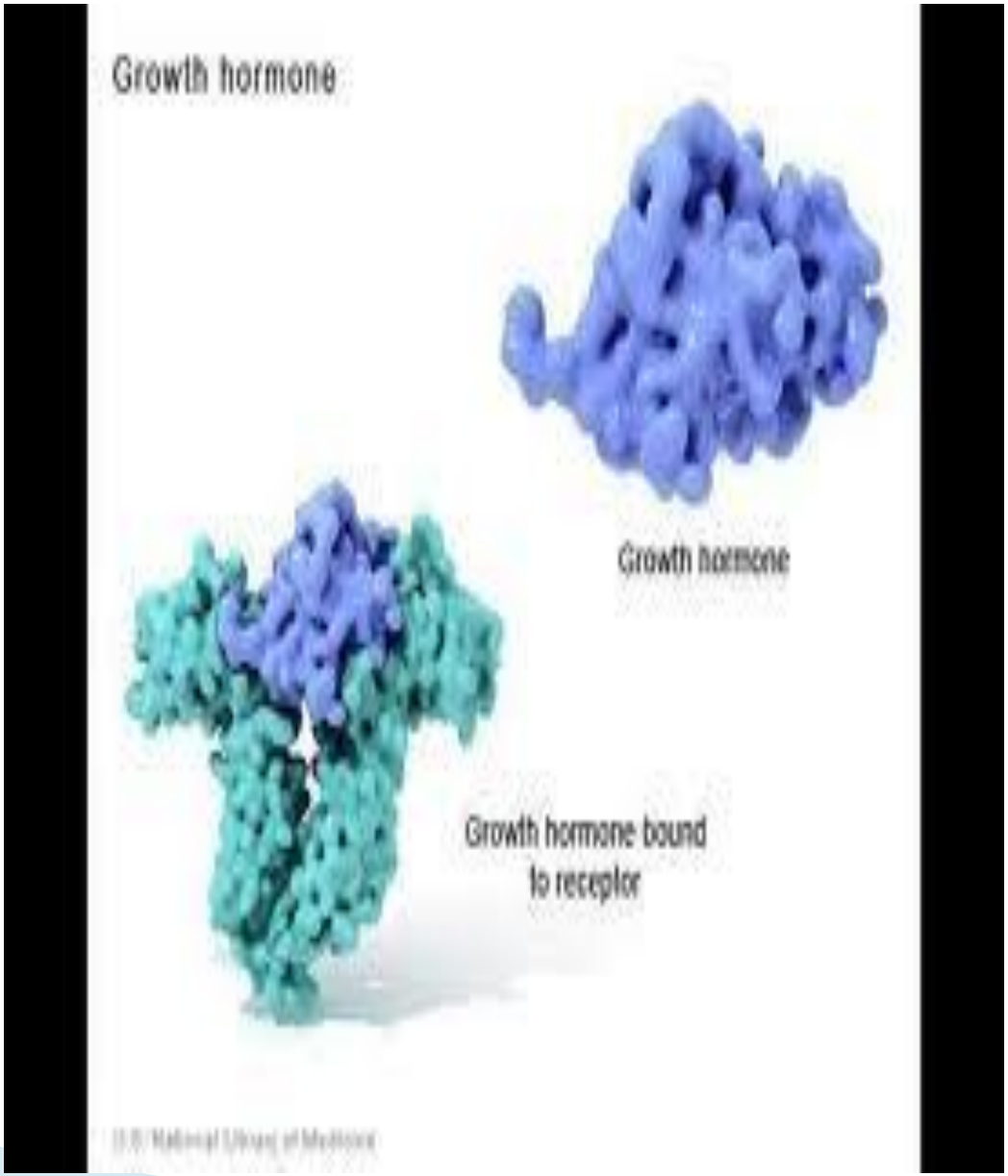


GROWTH HORMONE:

- It circulates in plasma in free as well as in bound form with a protein called GH-binding protein
- Its half life is 6-20 minutes.
- Hormone acts slowly from 1-2 hrs to several days.
- Acts by binding to specific membrane receptors on its target cells.

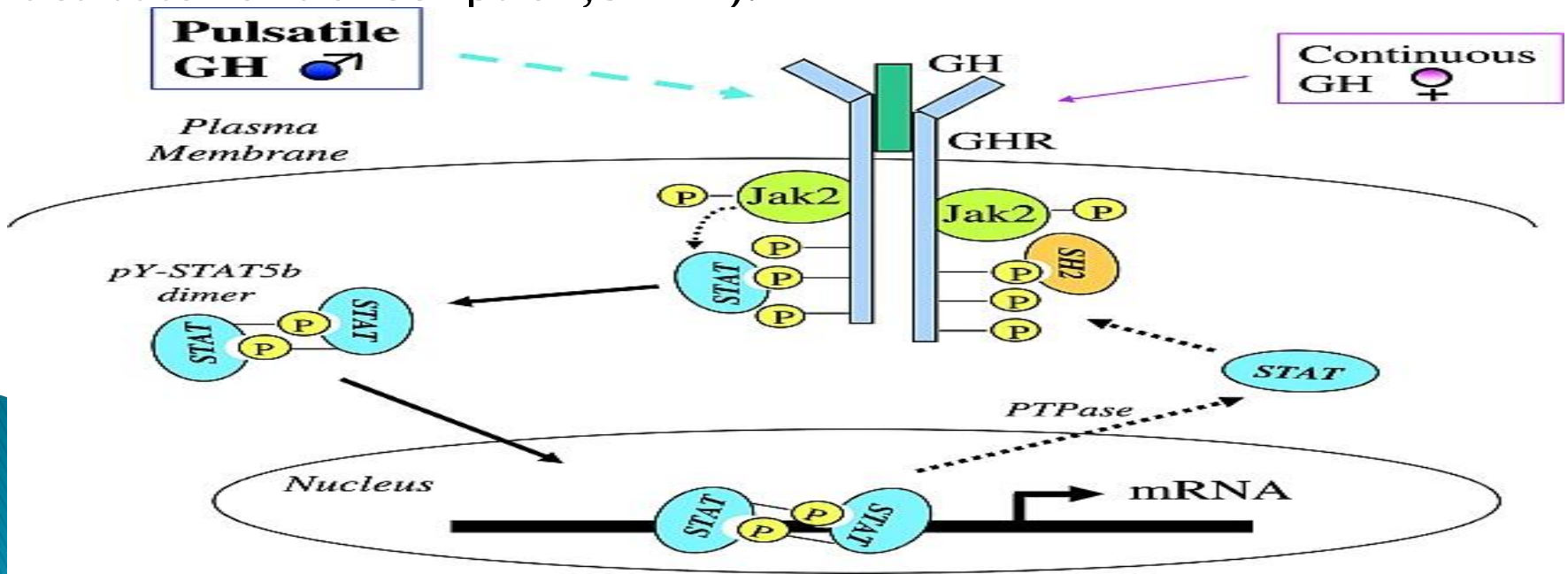
Mechanism of action of growth hormone

- GH acts by binding with single trans membrane receptor situated mainly in liver cells.
- The hormone receptor complex results in secretion of somatomedin C (IGF-1).



Mode of action of GH

- Janus kinase is family of intracellular non receptor tyrosine kinases.
- They posses two non identical phosphate transferring domains.
- These kinases phosphorylates one or more cytoplasmic proteins through binding to SH2 domains.
- This result in activation of cytosolic proteins(Signal transduction & activator of transcription,STAT).



ACTIONS OF GROWTH HORMONE

Growth Hormone mainly acts

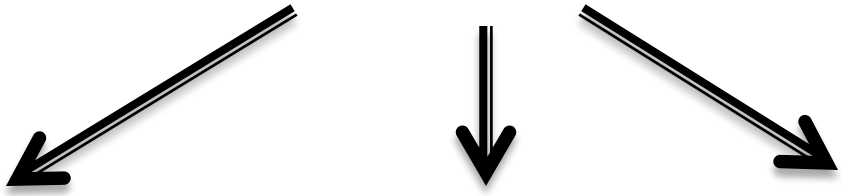
↑cell size
↑ mitotic division.

Specific differentiation of cells like Bone & Muscle.

General Growth of body.

ACTIONS OF GH ON METABOLISM

GH Increases



Increase rate of synthesis of protein in most of body cells

Lipolysis, increase use of FFA for energy

Hyperglycemia, rate of glucose utilization throughout the body.

PROTEIN METABOLISM:

- ↑the amino acid transport through the cell membrane
- ↑the DNA transcription to mRNA
- ↑the RNA translation to protein
- ↓the catabolism of proteins
- Promotes the anabolism of proteins.
- Increase protein synthesis results in increase growth of body, increase antibody formation and increase resistance to infection.

FAT METABOLISM

- GH mobilizes fats from adipose tissue, by activating **hormone sensitive lipase .**

- ↑ concentration of fatty acids in body fluids to provide energy.

- Excess mobilization of fats from adipose tissue causes accumulation of fat in liver, resulting in **fatty liver**.

CARBOHYDRATES METABOLISM

- The main action of **GH** on carbohydrates is conservation of Glucose.

- It reduces sensitivity of tissues to insulin .
- Decrease peripheral utilization of Glucose.
- Decreases uptake of Glucose by the cells.

- Increases deposition of Glycogen in the cells.
- Increase muscle and cardiac glycogen(reduce glycogenolysis).

DIABETOGENIC EFFECT OF GH:

- Hyper secretion of **GH** ↑ Blood glucose level enormously.
- It causes continuous stimulation of β-cells to secrete Insulin.
- Excess stimulation of β-cells in Pancreas destroys the β-cells causing deficiency of Insulin leading to DIABETES.

ACTIONS ON BONES

- **GH** is responsible for the differentiation and development of bone cells.
- **GH** causes conversion of chondrocytes into osteogenic cells thus causing deposition of new bones and also increases length and thickness of bones .
- Stimulates osteoblast activity ,therefore bones continue to become thicker.
- Increases intestinal absorption of calcium.
- Increases bone mineralization.

MODE OF ACTION OF GH ON BONES:

- **GH** does not acts on bones directly. It acts on bones through a substance called Somatomedin C ,secreted by Liver.
- **GH** stimulates liver to secrete somatomedin C.
- Inspite of normal secretion of **GH,** deficiency of Somatomedin causes **DWARFISM.**

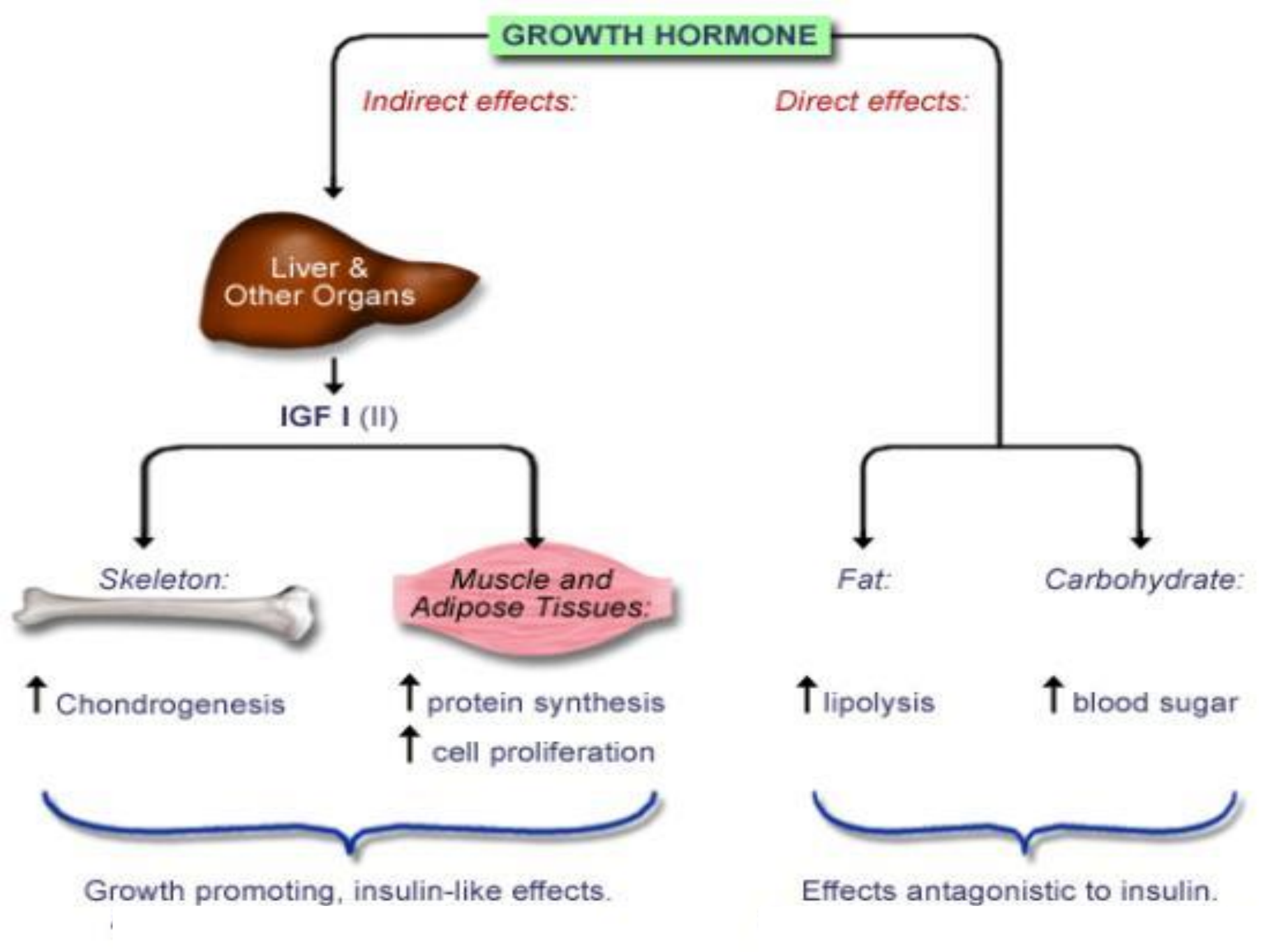
SOMATOMEDIN:

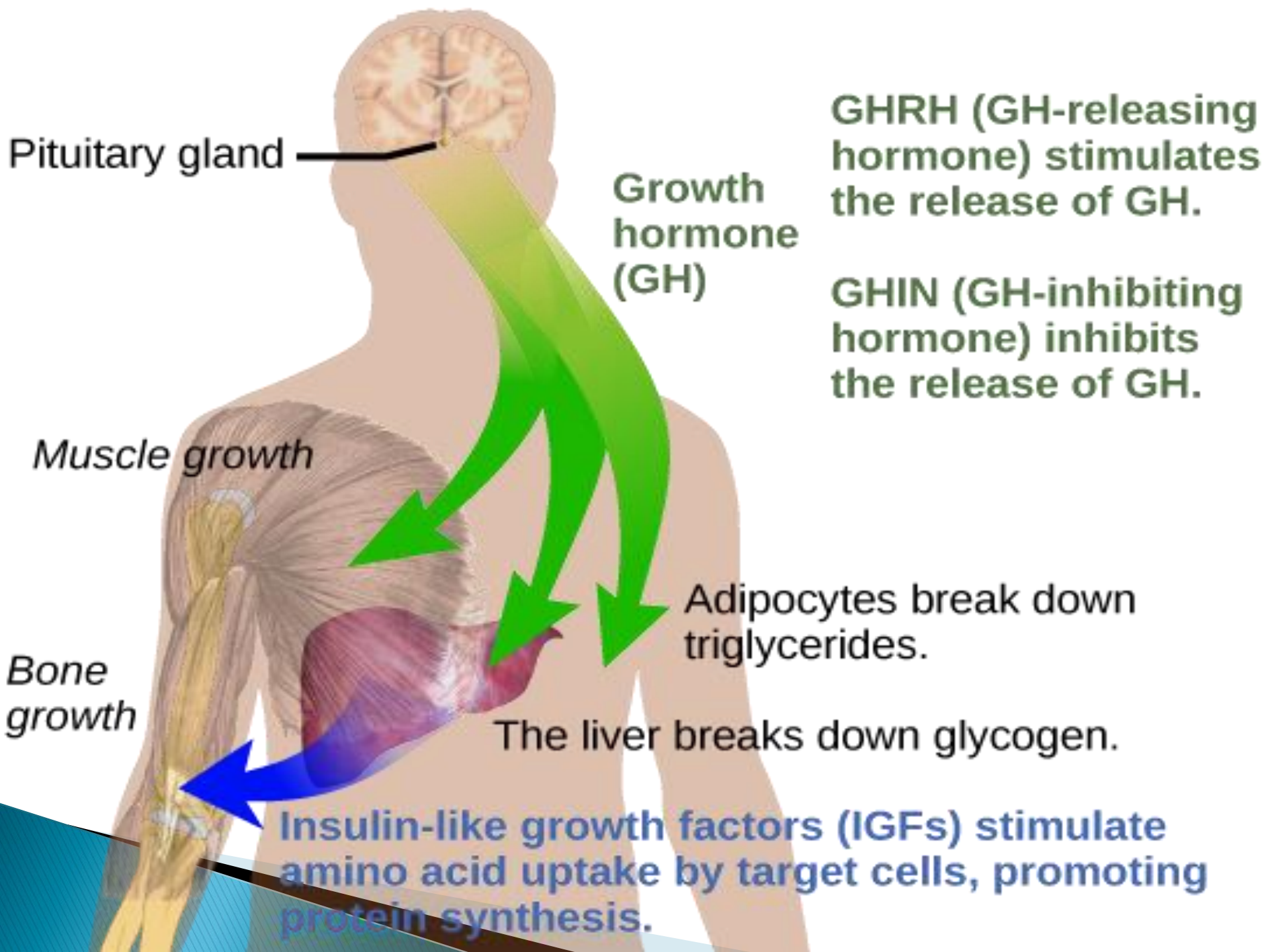
- Polypeptide with molecular weight of 7500 dalton.
- In Human beings only two Somatomedin are present;

I. IGF- I ⟹ Growth of Bones & Metabolic Functions.

II. IGF- II ⟹ Growth of Fetus.

- **GH** is transported in blood by loose binding with plasma proteins.
- It remains for 20 minutes in the blood.
- IGF- I strongly binds with plasma proteins and remains for 20 hours in the blood.

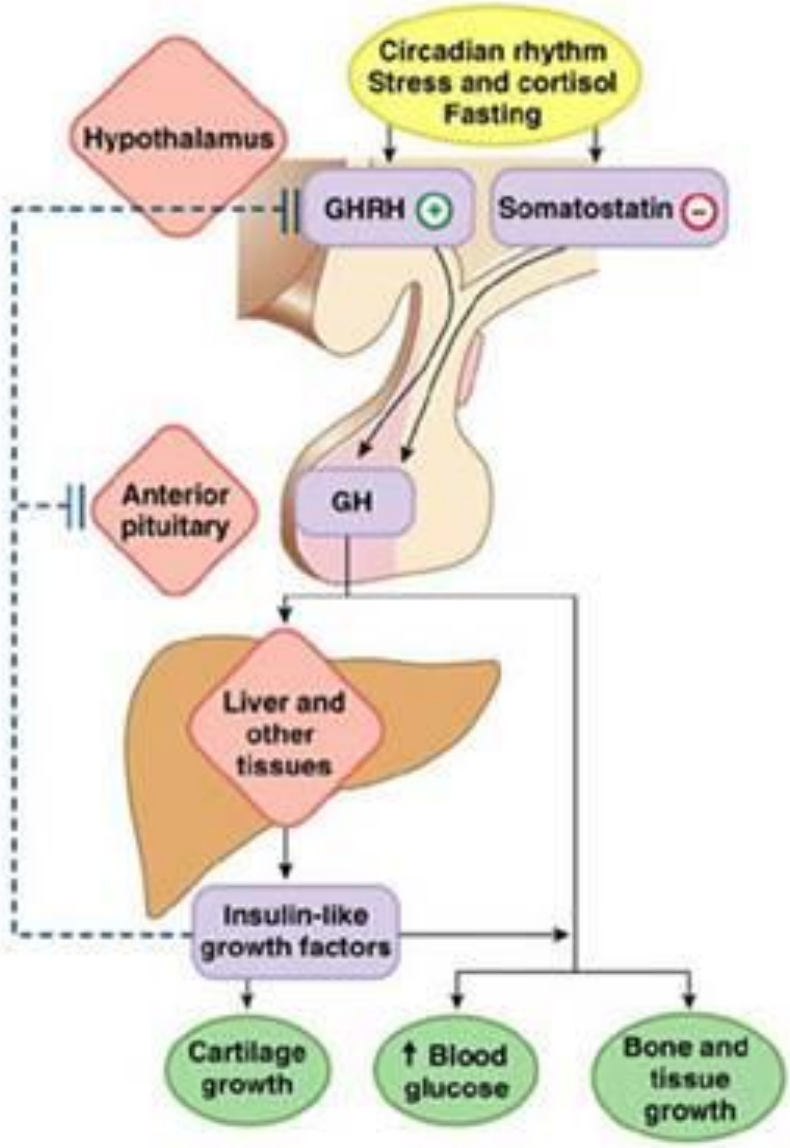

GROWTH HORMONE
Indirect effects:
Direct effects:
Liver & Other Organs
IGF I (II)
Skeleton:
Muscle and Adipose Tissues:
Fat:
Carbohydrate:
Chondrogenesis
protein synthesis
cell proliferation
lipolysis
blood sugar
Growth promoting, insulin-like effects.
Effects antagonistic to insulin.

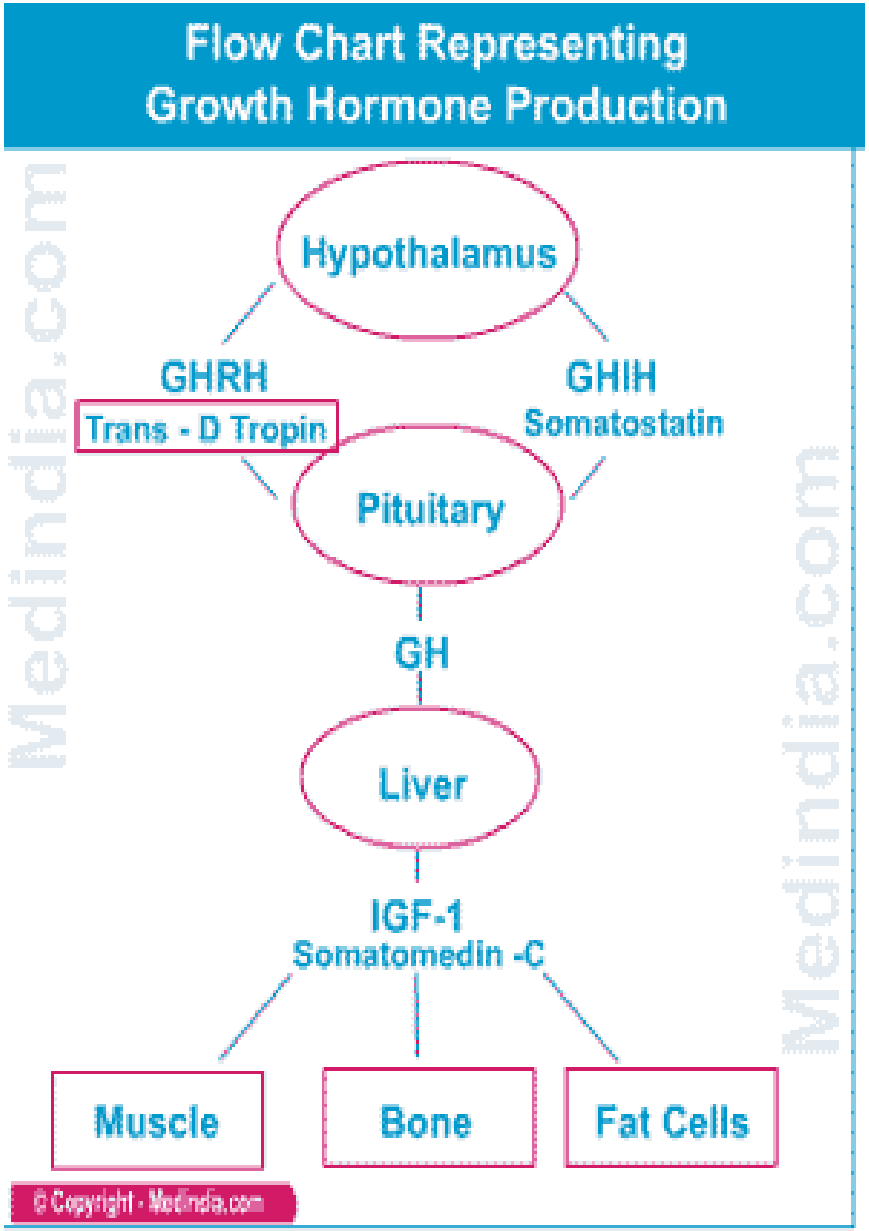

Pituitary gland
Growth hormone (GH)
GHRH (GH-releasing hormone) stimulates the release of GH.
GHIN (GH-inhibiting hormone) inhibits the release of GH.
Muscle growth
Adipocytes break down triglycerides.
Bone growth
The liver breaks down glycogen.
Insulin-like growth factors (IGFs) stimulate amino acid uptake by target cells, promoting protein synthesis.

REGULATION OF SECRETION OF GH:

- GH secretion is pulsatile i.e, increases and decreases .
- GH acts on somatotropes directly ,as well as through decreasing the release of GHRH from the hypothalamus.
- IGF-1 decreases the release of GH directly as well as by increasing the release of somatostatin(GHRIH) from hypothalamus.
- Hypothalamus controls the secretion of GH through two hormones, GHRH & GHRIH.

HOW HGH WORKS





REGULATION OF SECRETTION OF GH:

1. GH-RH(growth hormone releasing hormone)
2. GHRIH(growth hormone release inhibiting hormone, somatostatin) :

- **GHRIH suppresses secretion of GH**
- It blocks the TSH-releasing action of TRH
- It is also present in GIT
- It suppresses the secretion of gastrin
- It inhibits release of renin by kidney

REGULATION OF SECRETTION OF GH:

- GH secretion is also stimulated by dopamine.
- Ghrelin stimulates secretion of GH.
- GH concentration in normal adult blood is **300ng%.**
- In children it is about **500ng%** .

Stimulating factors

1. Protein deficiency due to starvation
2. Hypoglycemia
3. Low concentration of fatty Acids
4. Exercise
5. Excitement
6. Trauma
7. Stress
8. Androgen and estrogen
9. GHRH
10. First 2 hours of deep sleep
11. ADH
12. Drugs like Clonidine & L- DOPA

Inhibiting Factors

1. Hyperglycemia
2. Increased FFA concentration
3. Aging
4. Obesity
5. GHRIH or somatostatin
6. High GH level
7. Somatomedins
8. Glucocorticoids
9. Drugs like chlorpromazine

} Negative feed back inhibition

ABNORMALITIES OF GROWTH HORMONE

- DWARFISM
- GIGANTISM
- ACROMEGALY

DWARFISM

- TYPES GH , IGF_1,IGF-2 , Response to GH

1)GH-deff. ↓ ↓ ↓ – ⟷ Yes

Dwarfs

(GH deff.)

2)Pygmies ⟷ ↓ ⟷ No

(post rec.defect)

3) Laron type dwarfism ↑ ↓ ↓ No

(lack functional hepatic rec.)

Hypo secretion of GH:

- Dwarfism:
- In most instances generalized deficiency of anterior pituitary secretion **(pan hypo pituitarism**) during childhood.
- All the physical parts of the body develop in appropriate proportion to one another, but the rate of development is greatly decreased.
- Pan hypo pituitary dwarfism does not pass through puberty.
- In one third of such dwarfs, however, only growth hormone is deficient; these persons do mature sexually and occasionally reproduce .

TREATMENT:

- Dwarfs who have pure growth hormone deficiency can be completely cured if treated early in life.

DWARFISM

OVER SECRETION OF GH:

- In childhood
  - **Gigantism**
- In adults
  - **Acromegaly**

Gigantism

- **Overactive** Somatotropes in **childhood**
- Acidophilic Tumor in childhood
- ↑GH→ rapid **growth of all body tissues** including **bones**
- Height may reach up to **8 feet**
- **Hyperglycemia** is common
- Cells may be burst out →**Diabetes mellitus (10%)**
- **Treatment**
  - Surgical removal of tumor
  - Destruction of tumor by radiations

GIGANTISM

GIGANTISIM

A

B

C

Acromegaly:

- If acidophilic tumor occurs after adolescence,
- Bones can become thicker and the soft tissue can continue to grow,
- Marked in the bones of the hands and feet and in the membranous bones.

Acromegaly

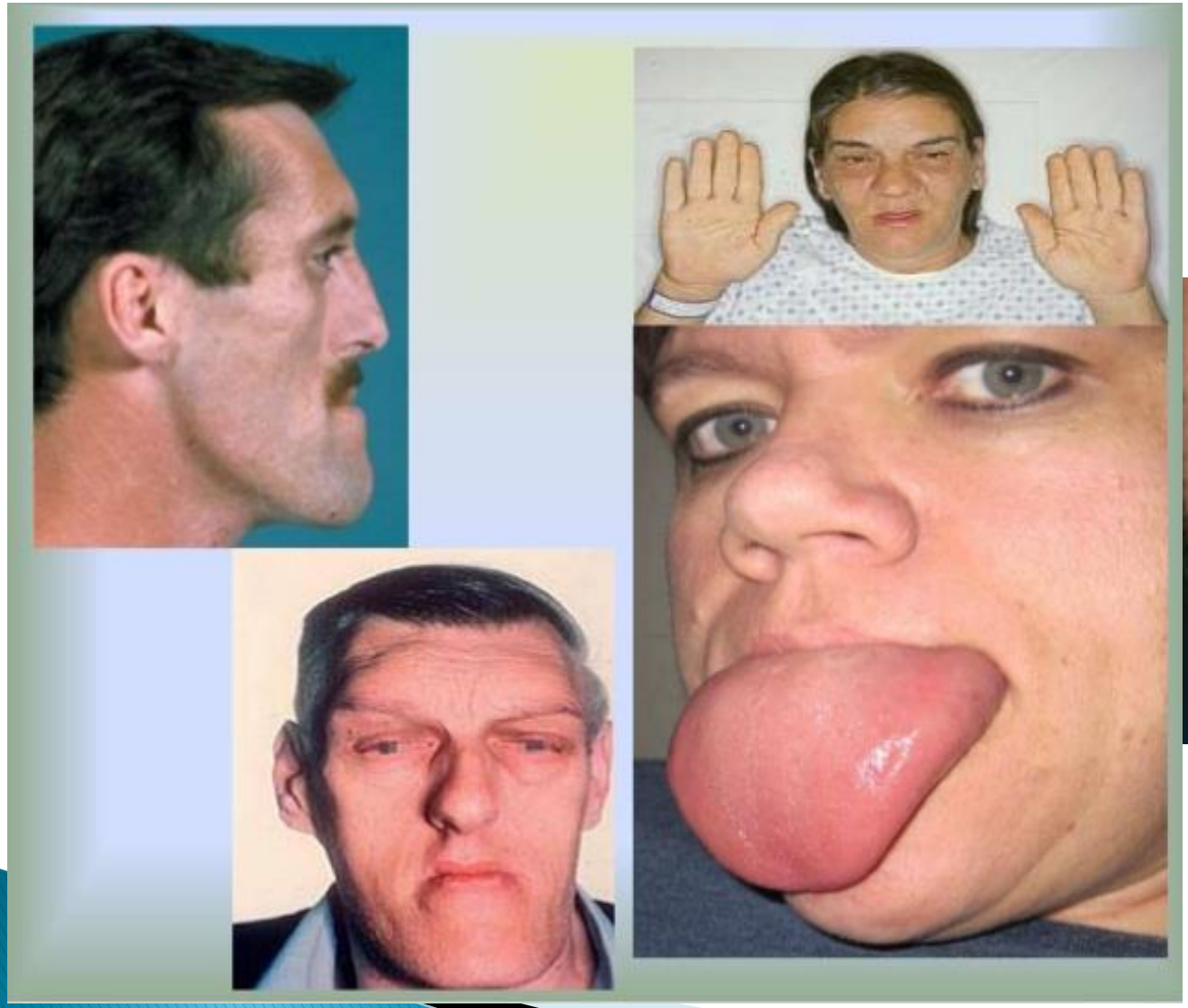
- Growth of **vertebra** → **Kyphosis** or **hunch back**

- **Soft tissues** grow excessively
  - Big nose
  - Thick and big lips
  - Macroglossa –big tongue
  - **Internal viscera** enlarged
    - Liver
    - Kidneys
    - GIT

- **Treatment** = Hypophysectomy

Acromegaly

ACROMEGALY



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- Harper
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