Endocrinology of Fish

MS I (Semester-II)

Maj/Zoo-S-406

Lecture – 06

Growth Hormone

Growth Hormone (GH)

somatotropic hormone or somatotropin

- A small protein molecule, that contains 191- aa in a single chain.
- Has great effect in growth and metabolism.
- Acts on all cells of the body throughout life.

Synthesis, transport, & mechanism of action of GH

Synthesized in ER of glandular cells as preprohormone; and stored in secretory vesicles in its active form until stimulated.

Dissolve freely in the blood.

Its receptors are found on or in cell membrane of target cells.

Stimulates G-proteins in the membrane of target cell, which stimulate (2) second messenger systems 1. adenyl cyclase \rightarrow cAMP.

2. phospholipase C \rightarrow IP₃/ Ca²⁺

Functions of growth hormone:

A) **Promotion of growth:**

increases cellular sizes and increase mitosis increases tissue growth and organ size.

IGF-1 IGF-2 are secreted by liver

Functions of growth hormone

B) Short- term metabolic effects:

1. Protein metabolism: Anabolic, ↑ rate of protein synthesis in all cells.

2. Fat metabolism: Catabolic,

 \uparrow mobilization of FFAs from adipose tissue stores to provide energy.

3. CHO metabolism: Hyperglycemic,

 \downarrow rate of glucose utilization throughout the body and \downarrow glucose uptake by cells.

GH enhances body protein, uses up fat stores, and conserves carbohydrates

Role of GH in promoting protein synthesis

- GH has 4 effects to \uparrow rate of protein synthesis in all cells of the body:
 - 1. Enhancement of aa transport through cell membranes.
 - 2. Enhancement of RNA translation to cause protein synthesis by the ribosomes.
 - 3. \uparrow nuclear transcription of DNA to form RNA.
 - 4. \downarrow catabolism of protein & aa.

The net result is more intracellular protein

Role of GH in Fat metabolism:

GH enhances fat utilization for energy

- 1. GH acts on fat cells (adipocytes) to release fatty acids from the triglycerides to the blood.
- 2. GH produces several 2 carbon fragments (acetates).

Since fatty acid is a stearic acid (C₁₄H₃₅COOH). GH acts on stearic acid \rightarrow several 2-carbon fargments (acetate CH₃COOH).

3. Formation of acetyl- CoA.

[acetate + Co-enzyme A (Co-A) \rightarrow acetyl-CoA].

4. Acetyl-CoA enters Krebs cycle to produce $CO_2 + H_2O$ + Energy.

Role of GH in Carbohydrate metabolism

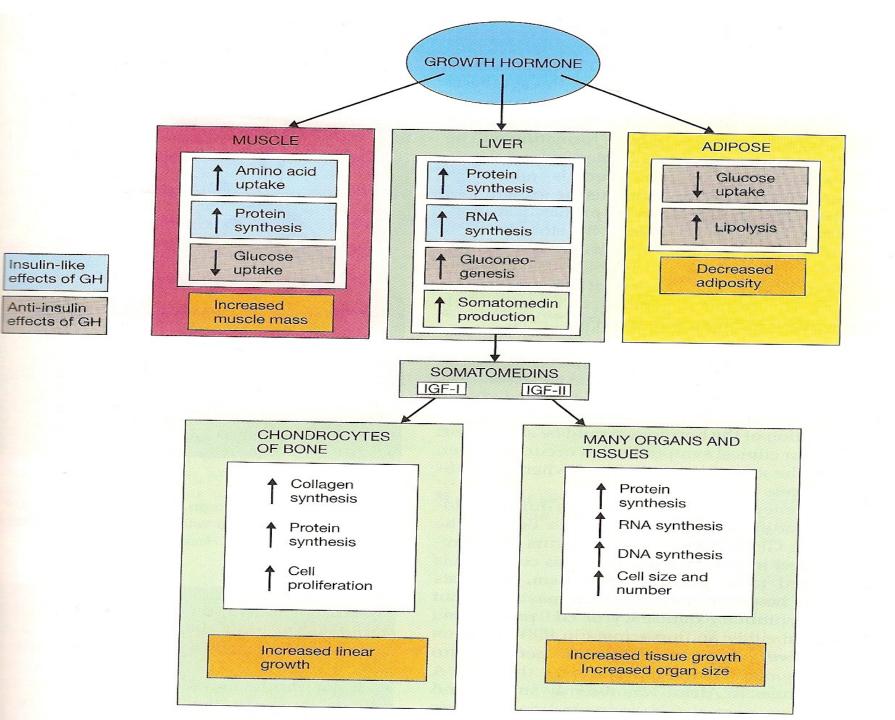
GH \downarrow CHO utilization:

- 1. Enhancement of glycogen deposition in the cell.
- Diminished uptake of glucose by the cells & ↑ blood glucose concentration – " Pituitary Diabetes".
- 3. \downarrow use of glucose for energy.
- 4. ↑ secretion of insulin Diabetogenic effect of growth hormone.

Role of GH in Carbohydrate metabolism

GH \downarrow CHO utilization:

- Usage of fat by Kreb's cycle reduces glucose breakdown.
- Cells build up glycogen up to certain limit.
- Glucose concentration \uparrow intracellularly until equilibrium with ECF.
- This block glucose entry into the cell.
- Blood glucose will \uparrow with next meal, which promotes insulin secretion till exhaustion of β cells of pancreas.



Control of GH secretion:

- 1. The hypothalamus:
 - a. GHRH $\rightarrow \uparrow$ GH secretion.
 - b. GHIRH (somatostatin) $\rightarrow \downarrow$ GH secretion.
- 2. Hypoglycemia $\rightarrow \uparrow$ GH secretion. (N.B. glucose intake $\rightarrow \downarrow$ GH secretion).
- 3. Muscular exercise $\rightarrow \uparrow$ GH secretion.
- 4. Intake of protein or amino acids $\rightarrow \uparrow$ GH secretion.