HORMONES

Dr. Mohammed Talat Tuzlu

The aims of the lecture

- To define the hormone.
- To know the effect of hormones.
- To classify the hormone.
- To identify Mechanism of hormone action.

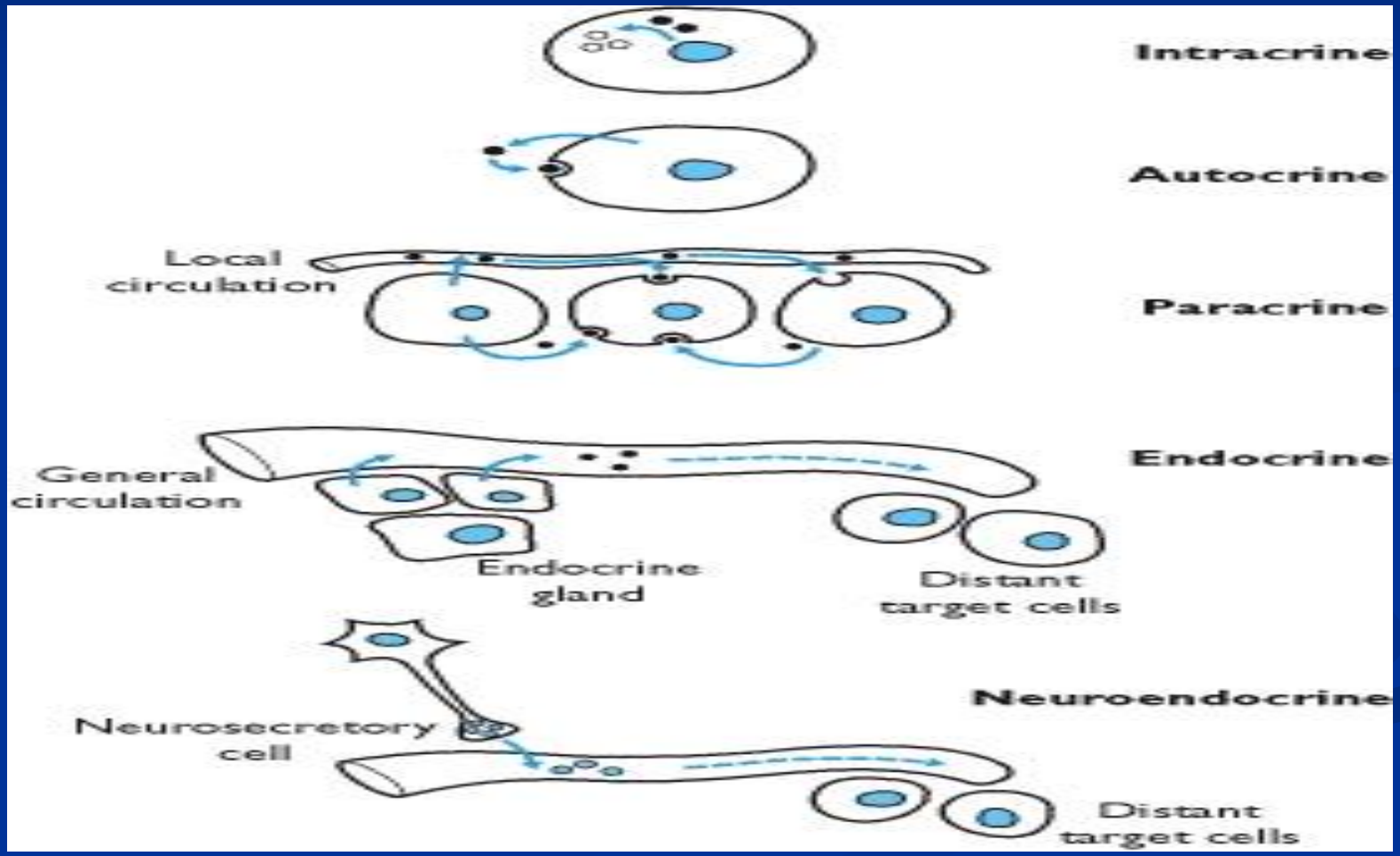
The word hormone is derived from the Greek V. hormo meaning (excit or activate).

What is the hormone?

Hormones: are the chemical signaling molecules produced by the endocrine glands and secreted directly into the blood stream. They travel through the blood to distant tissues and organs, where they can bind to specific cell sites called receptors.

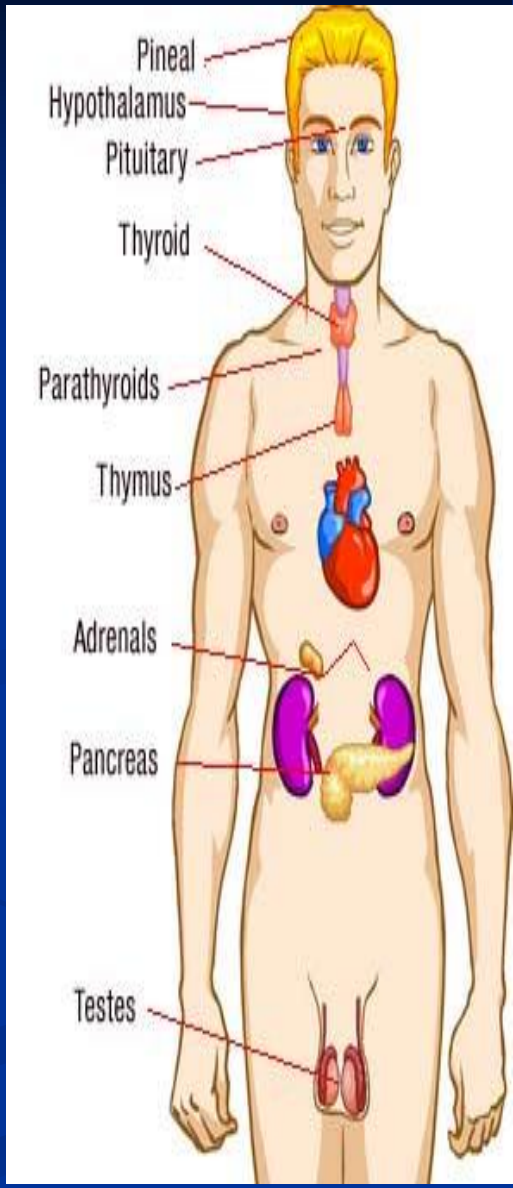
- Receptors have the following characteristics:
- 1.They have a high affinity for the hormone.
- 2.It is saturable.
- 3.The binding is readily reversible.
- 4.It is highly specific.

- Cells communicate with each other by chemical signals.
- There are many types of chemical signals can be distinguished ;



Types of glands

- Pineal gland secreted (melatonin and serotonin hormones).
- Anterior pituitary (LH ,FSH ,GH , prolactin ,ACTH ,TSH).
- Posterior pituitary (oxytocin , ADH).
- Thyroid gland (T4,T3).
- Parathyroid gland (parathyroid Hormon).
- Pancreatic gland (insulin ,glucagon ,somatostatin ,ppp).
- Adrenal medullary (epinephrine ,norepinephrine).
- Male(inhibin ,testosterone).
- Femal (progesterone ,HCG).



Effects of hormones

- Stimulation or inhibition of growth.
- Regulation of metabolism and nutrient supply.
- Preparation of the body for mating ,fighting , fleeing and other activity.
- Preparation of the body for a new phase of life, such as puberty and menopause.
- Control of the reproductive cycle.
- Maintenance of the internal environment.

Classification of hormone

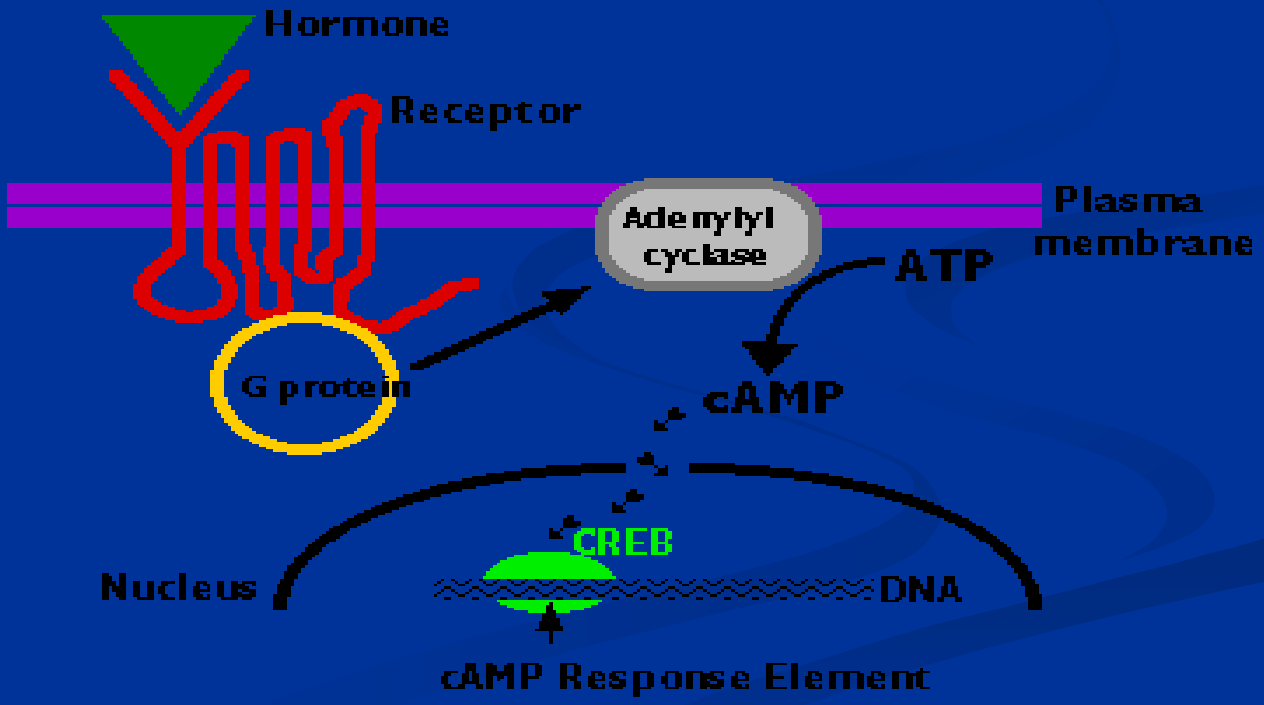
Hormones can be classified according to chemical composition ,solubility properties, location of receptors and nature of the signal used to mediate hormone action within the cell.

Table: the classification of hormone

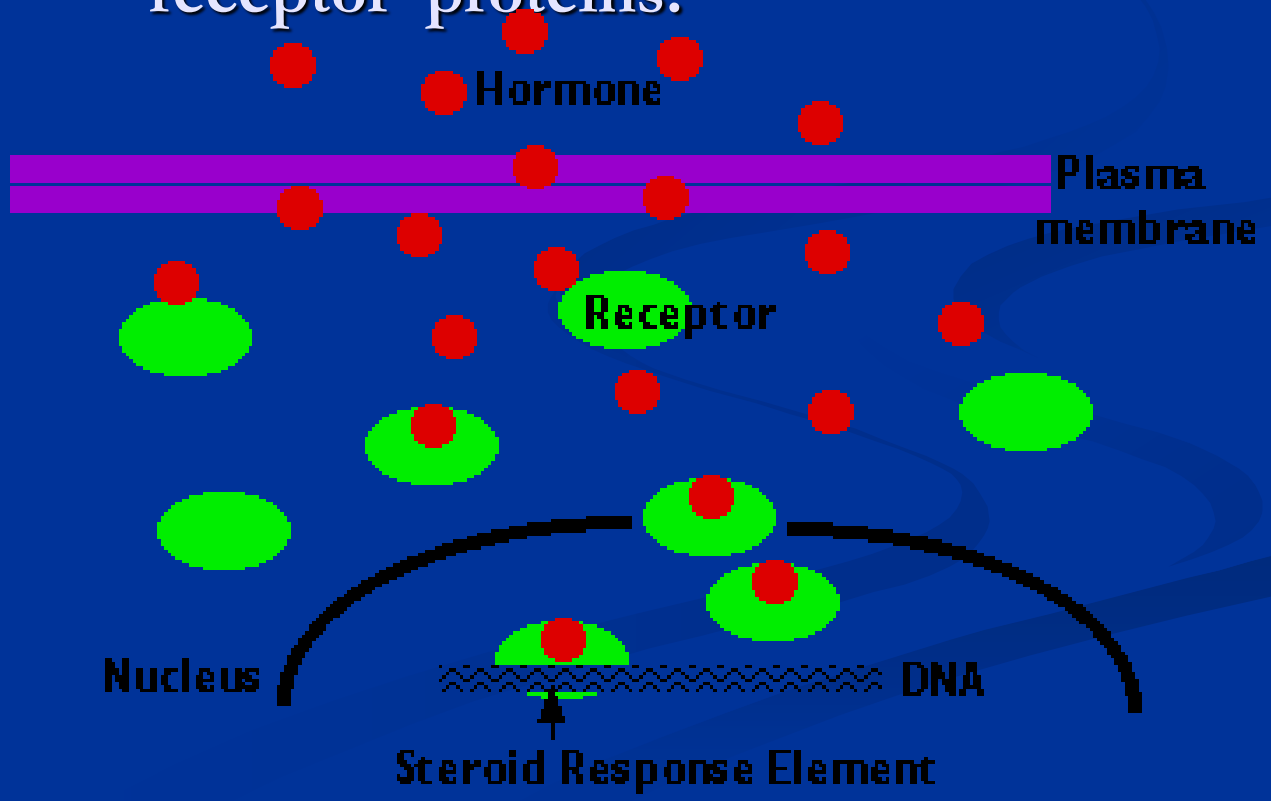
	Group 1	Group 2
Types	Lipid-soluble hormones(steriod,thyroid hormones) .	Water –soluble hormones(protein peptide and catecholamine hormones).
Solubility	Lipophilic	Hydrophilic
Transport proteins	Yes	No
Plasma half life	Long(hours to days)	Short(minutes)
Receptor	Intracellular	Plasma membrane
Medator	Receptor-hormone complex	cAMP,CGMP,Ca

Mechanism of hormone action:

A. Water –soluble hormones: These hormone bind to membrane receptores in their target tissues .receptor binding leads to the production of intracellular second messengers .



B. Lipid- soluble hormones: These hormones pass through the cell and bind to intracellular hormones receptor proteins.



Panceatic gland: insulin.glucagon.somatostatin.ppp

- Insulin is a polypeptide hormone produced by the B cells of the islets of Langerhans—clusters of cells that are embedded in the exocrine portion of the pancreas . The islets of Langerhans make up only about one to two percent of the total cells of the pancreas.

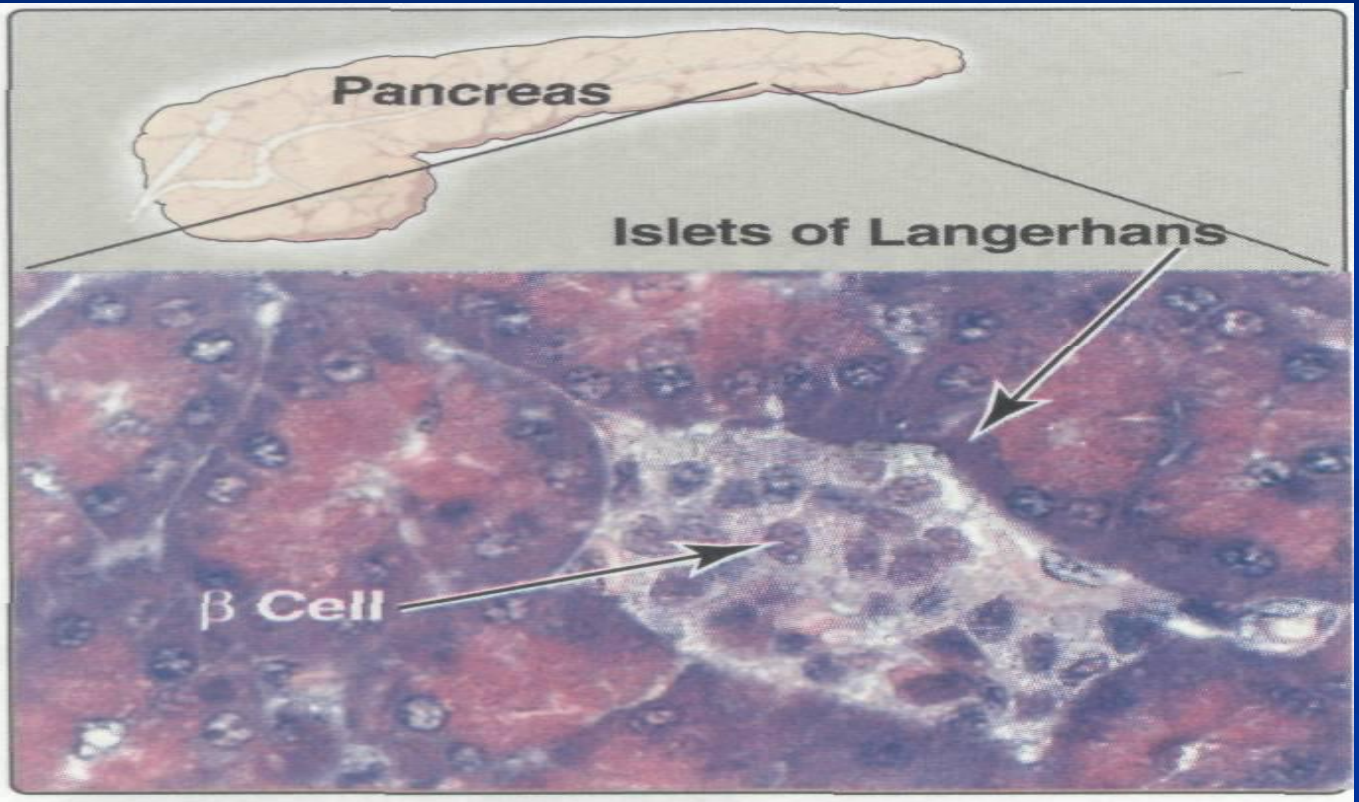


Figure 23.2
Islets of Langerhans.

- Insulin is the most important hormone coordinating the use of fuels by tissues. It is metabolic effects are **anabolic, favoring, for example, synthesis of glycogen, triacylglycerols, and protein.**

- **A. Structure of insulin**
- Insulin is composed of 51 amino acids arranged in two polypeptide chains, designated A and B, which are linked together by two disulfide bridges. The insulin molecule also contains an intramolecular disulfide bridge between amino acid residues of the A chain.

C. Regulation of insulin secretion

1. **Stimulation of insulin secretion: Insulin secretion by the B** cells of the islets of Langerhans of the pancreas is closely coordinated with the release of glucagon by pancreatic a cells. The relative amounts of insulin and glucagon released by the pancreas are regulated so that the rate of hepatic glucose production is kept equal to the use of glucose by peripheral tissues.

insulin synthesis and secretion are increased by:

a. **Glucose:** Glucose is the most important stimulus for insulin secretion.

- **Amino acids:** Ingestion of protein causes a transient rise in plasma amino acid levels, which, in turn, induces the immediate secretion of insulin. Elevated plasma arginine is a particularly potent stimulus for insulin synthesis and secretion.

Gastrointestinal hormones

D. Metabolic effects of insulin

- **1. Effects on carbohydrate metabolism: The effects of insulin on glucose metabolism are most prominent in three tissues: liver, Muscle** and adipose tissue.
- In the **liver, insulin decreases the production of glucose by inhibiting gluconeogenesis and the breakdown of glycogen.**

- In the **muscle and liver, insulin increases glycogen synthesis.**
- In the **muscle and adipose tissue, insulin increases glucose uptake by increasing the number of glucose transporters in the cell membrane . The intravenous administration of insulin thus causes an immediate decrease in the concentration of blood glucose.**

- 2. Effects on lipid metabolism: Adipose tissue responds within minutes to administration of insulin, which causes a significant redution in the release of fatty acids:

- a. Decreased **triacylglycerol degradation: Insulin decreases the level of circulating fatty acids by inhibiting the activity of *hormone-sensitive lipase in adipose tissue. Insulin probably acts by promoting the dephosphorylation and, hence, inactivation of the enzyme***

- b. Increased **triacylglycerol synthesis: Insulin increases the transport and metabolism of glucose into adipocytes, providing the substrate glycerol 3-phosphate for triacyglycerol synthesis. Insulin also increases the *lipoprotein lipase activity of adipose tissue by increasing the enzyme's synthesis, thus providing fatty acids for esterification***

- 3. Effects on protein synthesis: most tissues, insulin stimulates the entry of amino acids into cells, and protein synthesis.

Glucagon

Glucagon is a polypeptide hormone secreted by the **a cells of the pancreatic islets of Langerhans. Glucagon, along with epinephrine, Cortisol, and growth hormone (the "counterregulatory hormones"), opposes many of the actions of insulin. Most importantly, glucagon acts to maintain blood glucose levels by activation of hepatic** glycogenosis **and gluconeogenesis.**

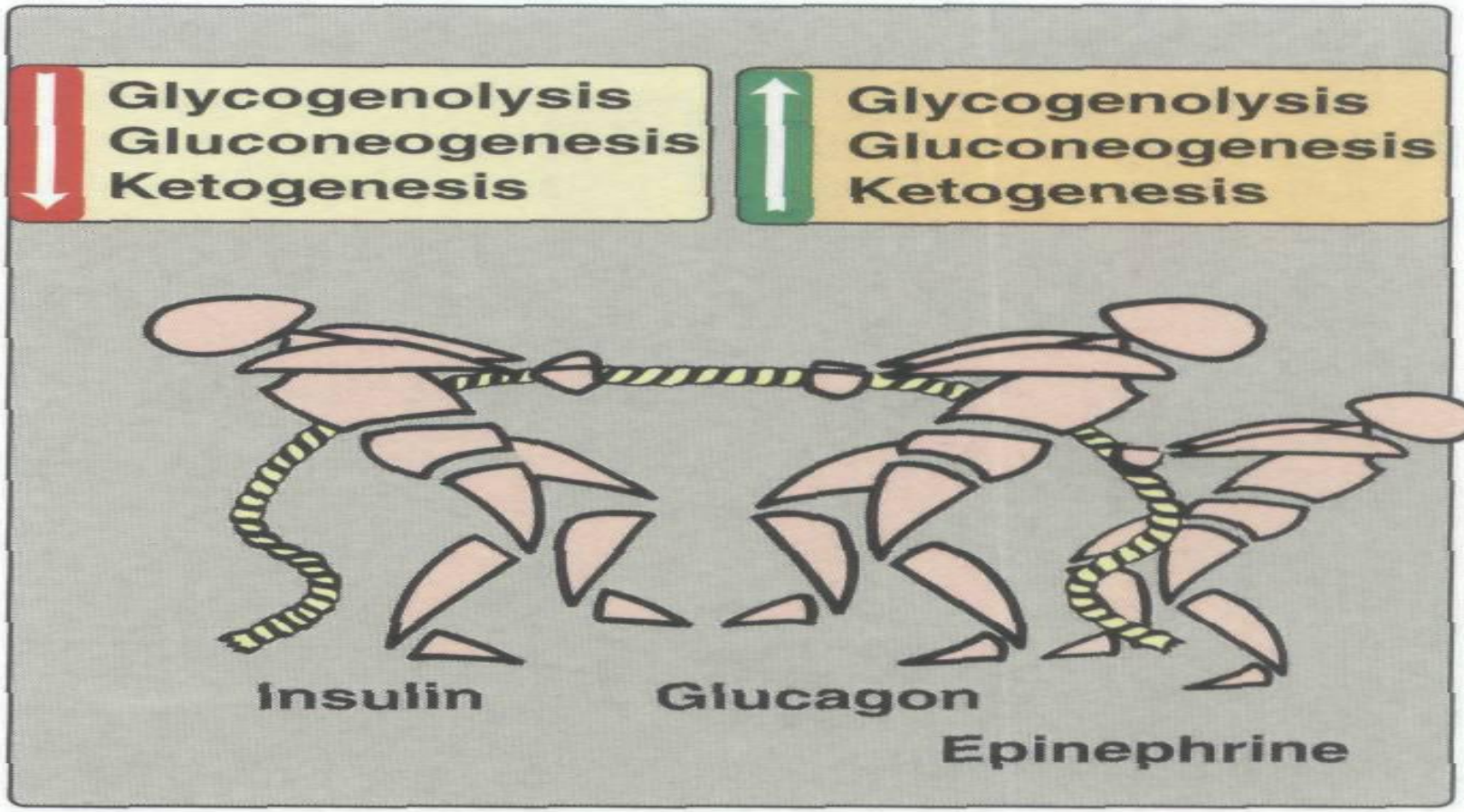


Figure 23.10
Opposing actions of insulin and glucagon plus epinephrine.

- Glucagon is composed of 29 amino acids arranged in a single polypeptide chain.

A. Stimulation of glucagon secretion

The a cell is responsive to a variety of stimuli that signal actual or potential hypoglycemia. Specifically, glucagon secretion is increased by:

- **Low blood glucose: A decrease in plasma glucose concentration is the primary stimulus for glucagon release. During an overnight or prolonged fast, elevated glucagon levels prevent hypoglycemia .**

- Amino acids: Amino acids derived from a meal containing protein stimulate the release of both glucagon and insulin.
- Epinephrine: Elevated levels of circulating epinephrine produced by the adrenal medulla, or norepinephrine produced by sympathetic innervation of the pancreas, or both, stimulate the release of glucagon.

- B. Inhibition **of glucagon secretion**
- Glucagon secretion is significantly decreased by elevated blood glucose and by insulin. Both substances are increased following ingestion of glucose or a carbohydrate-rich meal.

C. Metabolic effects of glucagon

- 1. Effects **on carbohydrate metabolism: The intravenous administration of glucagon leads to an immediate rise in blood glucose. This results** from an increase in the breakdown of liver (not muscle) glycogen and an increase in gluconeogenesis.

- Effects on lipid metabolism: Glucagon favors hepatic oxidation of fatty acids and the subsequent formation of ketone bodies from acetyl CoA. The lipolytic effect of glucagon in adipose tissue is minimal in humans.

- Effects on protein metabolism: Glucagon increases uptake of amino acids by the liver, resulting in increased availability of carbon skeletons for gluconeogenesis. As a consequence, plasma levels of amino acids are decreased.

- THANK YOU