

ENDOCRINE & PHARMACOLOGY OF DIABETES

Khder Hussein Rasul Pharmacology, MA 411 Spring Semester 7th week 22/04/2025



Outline

- Endocrine system
- Pharmacology of diabetes



Objectives

By the end of this lecture, students should be able to:

- 1. Understand endocrine system.
- 2. Being familiar more with hormone
- 3. Describe the action of drugs used in diabetes management.

Endocrine system, hormones and target tissues



- Endocrine system consists of endocrine glands that secrete chemicals called hormones and produces longterm responses.
- Endocrine glands: are ductless. This means that they do not have ducts to take their secretions to specific sites. Instead, hormones are secreted directly into capillaries and circulate in the blood throughout





- > Hormones are chemical messengers that stimulate specific cells or tissues into action.
- **Receptor** is a molecule inside or on the surface of a cell (target cell) that binds to hormone

Components of the endocrine system

Key Components of the endocrine system

- 1. Hypothalamus: controls the pituitary gland.
- 2. Pituitary gland: secretes hormones influencing other endocrine glands.
- 3. Thyroid gland: Regulates metabolism, energy production, and growth.
- 4. Parathyroid glands: Maintain calcium balance in the blood.
- 5. Adrenal glands: Produce stress hormones (cortisol, adrenaline) and regulate metabolism.
- 6. Pancreas: Controls blood sugar levels
- 7. Gonads (Ovaries & Testes): Responsible for reproductive hormones



Endocrine System



Endocrine glands



Location of endocrine glands

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Testosterone

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Chemistry of the hormones

Hormones are organized into three main classes based on their chemical structure:

1. Steroid hormones are synthesized from cholesterol

- Steroid hormones are lipid-soluble, so they can pass through cell membranes to reach receptor molecules located inside their target cells.
- Example of steroid hormones: aldosterone, estrogen, and testosterone.







Chemistry of the hormones

2. Peptide and protein hormones are structured from chains of amino acids

These hormones are chains of amino acids

- Short chains of amino acids called peptides
- > Oxytocin is peptide hormone
- ➢ Long chains of amino acids called proteins.
- > Insulin is protein hormone.





Chemistry of the hormones



3. Amine hormones are modified amino acids (Amino acid derivatives)

- > These simple hormones are structural variations of the amino acids.
- The derivatives of tyrosine, such as the thyroid hormones released by the thyroid gland.
- > Melatonin, secreted by the pineal gland, is derived from tryptophan.





Pharmacology of Diabetes Mellitus



Diabetes is a chronic metabolic disorder characterized by high blood sugar levels (hyperglycemia) due to defects in insulin production, insulin action, or both.

Types of Diabetes Mellitus

- 1. Type 1 Diabetes Mellitus (T1DM) Insulin-dependent diabetes
- 2. Type 2 Diabetes Mellitus (T2DM) Insulin resistance diabetes

Type 1 Diabetes Mellitus (T1DM) – Insulin-Dependent Diabetes



Type 1 Diabetes Mellitus (T1DM) – Insulin-Dependent Diabetes

An autoimmune disorder where the body's immune system attacks pancreatic β -cells, leading to little or no insulin production.

Causes: Autoimmune destruction of insulin-producing β -cells in the pancreas.

Onset: Usually in childhood or adolescence but can occur at any age.

Treatment: Requires lifelong insulin therapy.

Symptoms: Rapid weight loss, excessive thirst (polydipsia), frequent urination (polyuria), and fatigue.

Type 2 Diabetes Mellitus (T2DM) – Insulin Resistance Diabetes



- ➤ A metabolic disorder where cells become resistant to insulin.
- > **Causes:** Obesity, sedentary lifestyle and genetics.
- > **Onset:** More common in adults over 40.
- > **Treatment:** Lifestyle changes and oral medications (Metformin).
- Symptoms: Often mild at first—fatigue, slow wound healing, frequent infections.

Insulin



- > Insulin is a hormone secreted by the β -cells of the islets of Langerhans in the pancreas.
- Blood glucose stimulates insulin release.
- Insulin binds to specific receptors in the cell membranes, initiating a number of actions, including an increase in glucose uptake by the muscle, liver and adipose tissue.
- In diabetes mellitus, there is a relative or total absence of insulin, which causes reduced glucose uptake by insulin-sensitive tissues and has serious consequences.
- ▶ Lipolysis and muscle proteolysis result in weight loss and weakness.





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Pharmacology of Diabetes Mellitus



Short-acting insulins

For example Insulin lispro

- Rapid-acting insulin analog 1.
- 2. Onset of action 10-15 minutes
- 3. Peak action 30-90 minutes
- Duration of action 3-5 hours 4.
- 5. Route of administration Subcutaneous (SC) injection, IV (in hospital settings)
- Half-Life ~1 hour 6.
- 7. Time to administer 5-15 minutes before meals



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Mechanism of action Insulin lispro



1. Binds to insulin receptors on target cells (liver, muscle, adipose tissue) \rightarrow stimulates glucose uptake and inhibits glucose production.

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- 2. Promotes glycogenesis
- 3. Inhibits lipolysis
- 4. Enhances protein synthesis





Intermediate and long acting



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Oral antidiabetic drugs



Sulphonylureas and rapaglinide stimulate insulin release from the pancreatic islets and so the patient must have partially functional β -cells for these drugs to be of use.

Hypoglycaemia and hypoglycaemic coma may be induced by longer-acting drugs, especially in elderly patients.



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Oral antidiabetic drugs



Metformin

- Metformin is the first-line drug for patients with type 2 diabetes
- 2. Metformin reduces hepatic glucose production and acts peripherally to increase glucose uptake.
- it does not increase insulin release, it rarely causes hypoglycaemia.
- Adverse effects include nausea, vomiting, diarrhoea and, very occasionally, potentially fatal lactic acidosis.

