

HUMAN ANATOMY & PHYSIOLOGY-II- BP201T

UNIT: 4 (ENDOCRINE SYSTEM)

CLASS: 8

TOPIC: Pancreas

Endocrine function of pancreas is performed by the islets of Langerhans. Islets of Langerhans consist of four types of cells:

1. A cells or α -cells, which secrete glucagon
2. B cells or β -cells, which secrete insulin
3. D cells or δ -cells, which secrete somatostatin
4. F cells or PP cells, which secrete pancreatic polypeptide.

INSULIN

Insulin is secreted by B cells or the β -cells in the islets of Langerhans of pancreas. Insulin is a polypeptide with 51 amino acids. It has two amino acid chains called α and β chains, which are linked by disulfide bridges. The biological half-life of insulin is 5 minutes.

SYNTHESIS

Synthesis of insulin occurs in the rough endoplasmic reticulum of β -cells in islets of Langerhans. It is synthesized as preproinsulin, that gives rise to proinsulin. Proinsulin is converted into insulin and C peptide through a series of peptic cleavages. C peptide is a connecting peptide that connects α and β chains. At the time of secretion, C peptide is detached.

Preproinsulin → Proinsulin

Peptic cleavage ↓

Insulin

ACTIONS OF INSULIN

Insulin is the important hormone that is concerned with the regulation of carbohydrate metabolism and blood glucose level. It is also concerned with the metabolism of proteins and fats.

1. On Carbohydrate Metabolism

Insulin is the only antidiabetic hormone secreted in the body, i.e. it is the only hormone in the body that reduces blood glucose level. Insulin reduces the blood glucose level by its

following actions on carbohydrate metabolism:

- i. Increases transport and uptake of glucose by the cells

Insulin facilitates the transport of glucose from blood into the cells by increasing the permeability of cell membrane to glucose. Insulin also increases the number of glucose transporters, especially GLUT 4 in the cell membrane. Glucose transporters: Usually, glucose is transported into the cells by sodium-glucose symport pump. In addition to symport pump, most of the cells have another type of transport proteins called glucose transporters (GLUT). Seven types of GLUT are identified (GLUT 1–7), GLUT4 is insulin sensitive.

- ii. Promotes peripheral utilization of glucose

- iii. Promotes storage of glucose – glycogenesis

- iv. Inhibits glycogenolysis

- v. Inhibits gluconeogenesis

2. On Protein Metabolism

Insulin facilitates the synthesis and storage of proteins and inhibits the cellular utilization of proteins by the following actions:

- i. Facilitating the transport of amino acids into the cell from blood

- ii. Accelerating protein synthesis by influencing the transcription of DNA and by increasing the translation of mRNA

- iii. Preventing protein catabolism by decreasing the activity of cellular enzymes which act on proteins

- iv. Preventing conversion of proteins into glucose.

3. On Fat Metabolism

Insulin stimulates the synthesis of fat. It also increases the storage of fat in the adipose tissue. Actions of insulin on fat metabolism are:

- i. Synthesis of fatty acids and triglycerides

- ii. Transport of fatty acids into adipose tissue

- iii. Storage of fat

4. On Growth

Along with growth hormone, insulin promotes growth of body by its anabolic action on proteins. REGULATION OF INSULIN SECRETION

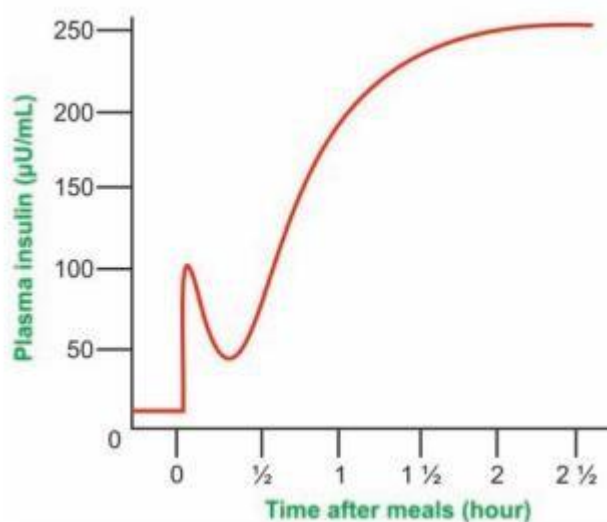
Insulin secretion is mainly regulated by blood glucose level.

1. Role of Blood Glucose Level

When blood glucose level is normal (80 to 100 mg/dL), the rate of insulin secretion is low (up to 10 μ U/minute). When blood glucose level increases between 100 and 120 mg/dL, the rate of insulin

secretion rises rapidly to 100 μ U/minute. When blood glucose level rises above 200 mg/dL, the rate of insulin secretion also rises very rapidly up to 400 μ U/minute. Biphasic effect of glucose Action of blood glucose on insulin secretion is biphasic. i. Initially, when blood glucose level increases after a meal, the release of insulin into blood increases rapidly. Within few minutes, concentration of insulin in plasma increases up to 100 μ U/mL from the basal level of 10 μ U/mL. It is because of release of insulin that is stored in pancreas. Later, within 10 to 15 minutes, the insulin concentration in the blood reduces to half the value, i.e. up to 40 to 50 μ U/mL of plasma.

ii. After 15 to 20 minutes, the insulin secretion rises once again. This time it rises slowly but steadily. It reaches the maximum between 2 and 2½ hours. The prolonged increase in insulin release is due to the formation of new insulin molecules continuously from pancreas.



GLUCAGON

Glucagon is secreted from A cells or α -cells in the islets of Langerhans of pancreas. It is also secreted from A cells of stomach and L cells of intestine. It contains 29 amino acids. Half-life of glucagon is 3 to 6 minutes.

SYNTHESIS

Glucagon is synthesized from the prehormone precursor called preproglucagon in the α -cells of islets. Preproglucagon is converted into proglucagon, which gives rise to glucagon.

ACTIONS OF GLUCAGON

Actions of glucagon are antagonistic to those of insulin. It increases the blood glucose level, peripheral utilization of lipids and the conversion of proteins into glucose.

REGULATION OF GLUCAGON SECRETION

Secretion of glucagon is controlled mainly by glucose and amino acid levels in the blood.