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Topic: Pancreas (Islets of langerhans)

Pancreas (islets of langerhans)

Pancreas is a composite gland which acts as both exocrine and endocrine gland. The exocrine cells of pancreas are arranged in clusters called acini.

The acini produce digestive enzymes, which flow into the gastrointestinal tract through the pancreatic duct.

Scattered throughout the pancreas between the acini are clusters, or islands, of endocrine cells known as the islets of Langerhans (or pancreatic islets).

The islets make up about 1% to 2% of the total pancreatic mass. Each pancreatic islet includes four types of hormone-secreting cells:

1. **Alpha** or **A-cells:** constitute about 17% of pancreatic islet cells and secrete glucagon.

2. **Beta** or **B-cells:** constitute about 70% of pancreatic islet cells and secrete insulin.

3. **Delta or D-cells:** constitute about 7% of pancreatic islet cells and secrete somatostatin (identical to the growth hormone –inhibiting hormone secreted by the hypothalamus).

   Somatostatin inhibits secretion of insulin and glucagon and slows absorption of nutrients from the gastrointestinal tract.

4. **F- cells:** constitute the remainder of pancreatic islet cells and secrete pancreatic polypeptide.

   Pancreatic polypeptide inhibits somatostatin secretion, gallbladder contraction, and secretion of digestive enzymes by the pancreas.

Glucagon and insulin:

Glucagon is a linear polypeptide of 29 amino acid residues. The effects of glucagon are opposite from those of insulin.

It stimulates glycogenolysis resulting in an increased level of glucose in the blood (hyperglycemia).It also stimulates the process gluconeogenesis.

Function:

- Glycogenolysis (the breakdown of glycogen into glucose) : Increase
- Glycogenesis (the production of glycogen from glucose): Decrease
- Gluconeogenesis (synthesis of glucose from non-carbohydrate): Increase
- Triacylglycerol hydrolysis : Increase
- Blood glucose level : Increase

- Glycolysis : Decrease
- Glucose release from liver: Increase

Insulin is a protein made up of two polypeptide chains designated as A (21 amino acid residues) and B (30 amino acid residues) that are joined by two pairs of disulfide bounds with an additional intramolecular disulfide bound in the A chain.

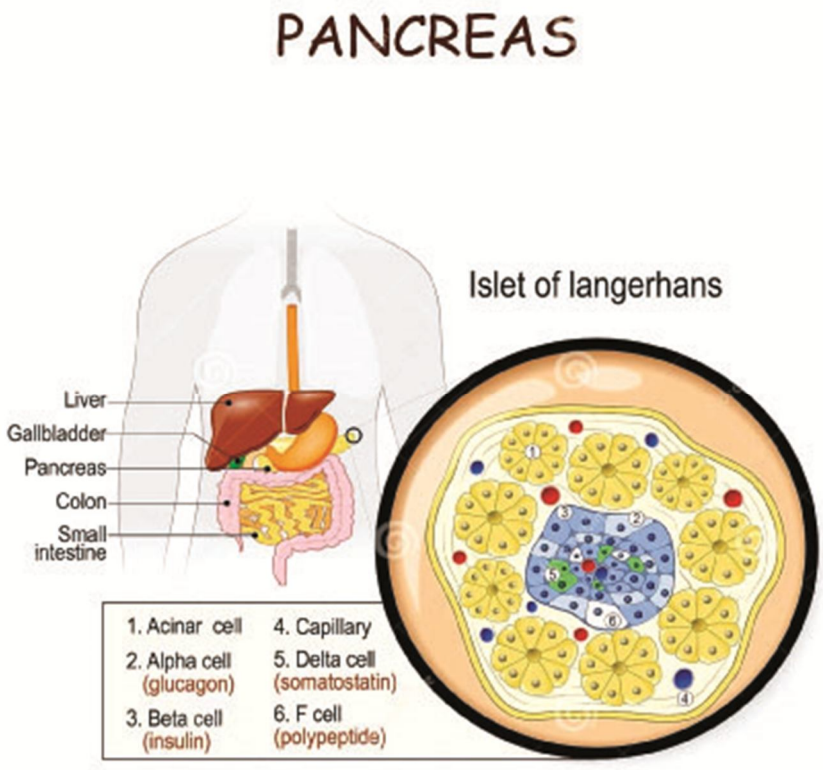
Insulin is first synthesized as preproinsulin (110 amino acid residues). Preproinsulin is a biologically inactive precursor.

During processing of preproinsulin, removal of the signal peptide from the N-terminus of preproinsulin generates the proinsulin molecule.

Further proteolytic cleavage of proinsulin removes the C- peptide chain producing mature insulin.

Function:

- Insulin lowers blood glucose level by accelerating transport of glucose into cells.
- Insulin stimulates glycogenesis in both skeletal muscle and the liver.
- Insulin inhibits glycogenolysis.
- Insulin inhibits gluconeogenesis in the liver.
- It enhances the entry of fatty acids from the blood into adipose tissue cells and increases lipogenesis.it inhibits lipolysis (fat breakdown).
- It stimulates protein synthesis and inhibits protein degradation.



Mechanism of glucose uptake by cell in the presence of insulin

Insulin lowers blood glucose level by accelerating transport of glucose into cells. Glucose transport between blood and cells is accomplished by means of a plasma membrane bound carrier protein known as a glucose transporter (GLUT).

Fourteen isoforms of glucose transporters have been identified, named in the order, they were discovered-(GLUT-1, GLUT-2, and so on .GLUT-4 is the only type of transporter that responds to insulin.

Unlike the other types of GLUT molecules, which are always present in the plasma membranes, GLUT-4 is not present in the plasma membrane in the absence of insulin.

It is stored in intracellular vesicles, which upon insulin stimulation, fuses with the plasma membrane, thereby increasing the rate of sugar uptake by several-fold.

Regulation of glucagon and insulin secretion

The principal action of glucagon is to increase blood glucose level when it falls below normal.

Insulin, on the other hand, helps lower blood glucose level when it is too high. The level of blood glucose controls secretion of glucagon and insulin via negative feedback.

Low blood glucose (Hypoglycemia) Stimulates alpha cells to secrete ↓ Glucagon ↓ Glucagon act on hepatocytes to Induce glycogenolysis and Gluconeogenesis ↓ Glucose released by hepatocytes raises blood glucose level to normal ↓ If blood glucose continues to rise Hyperglycemia inhibits release of glucagon.	High blood glucose (Hyperglycemia) stimulates beta cells to secrete ↓ Insulin ↓ Insulin acts on various body cells to accelerate diffusion of glucose into cells. Increase glycogenesis and lipogenesis. slow glycogenolysis and gluconeogenesis ↓ Blood glucose level falls ↓ If blood glucose continues to fall, hypoglycemia inhibits release of insulin.