Insulin Regulation

Insulin is regulated in several ways. Glucose is the primary regulator. Incretins such as GLP-1 and GIP are released in response to an oral glucose load. Positive regulators of insulin secretion are stimulation of beta-2 and m3-acetylcholine receptors. Negative regulators include alpha-2 receptor stimulation and somatostatin.



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Master Regulator

Glucose
Glue-bottle
Glucose is the primary regulator of insulin secretion. High blood glucose (hyperglycemia) will induce insulin release. In contrast, low blood glucose will decrease insulin release.

Incretins Released with Oral Glucose
Ink-crouton released by Mouth-glue-bottle
The fed state will stimulate the production of incretin hormones, including GLP-1 and GIP. Oral glucose will trigger the secretion of insulin 2-3x more than intravenous glucose administration due to incretin hormone involvement. Insulin works by upregulating glycolysis and reducing gluconeogenesis.

GLP-1
big GuLP with (1) Wand
GLP-1 (Glucagon-like Peptide-1) is an incretin hormone secreted by the colon and lower intestinal L cells after a meal, enhancing pancreatic beta cell sensitivity to glucose. It reduces glucagon secretion and delays gastric emptying. GLP-1 works by binding to cell surface receptors coupled with G protein-adenylyl cyclase system and is degraded by dipeptidyl peptidase-4 (DPP-4). GLP-1 increases glucose-dependent insulin release.

GIP
Stomach in Inhibiting-chains and Pimp-tie
GIP (Gastric Inhibitory Polypeptide or Glucose-dependent Insulinotropic Polypeptide) is an incretin hormone secreted by upper small intestinal K cells. It inhibits gastric acid secretion and promotes insulin secretion.

Positive Regulators

Beta-2 Receptor Stimulation
Beta-fish (2)-tutu Receptor Stimulated
The beta-2 receptor is present in pancreatic beta cells, and is responsible for stimulating insulin secretion. The beta-2-adrenergic receptor is a Gs protein-coupled receptor, which activates adenylyl cyclase and raises intracellular cAMP.

M3 Acetylcholine Receptor Stimulation
Mustache (3) Tree A-seagull-cola Receptor Stimulated
Muscarinic M3 receptors are part of the parasympathetic nervous system and can induce insulin secretion. The smell or scent of food can trigger these. The muscarinic-M3 receptor is a Gq protein-coupled receptor which activates adenylyl cyclase and raises intracellular cAMP.

Negative Regulators

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Alpha-2 Receptor Stimulation

Afro (2) Tutu Receptor Stimulated

The alpha-2 receptor is a part of the sympathetic system present in pancreatic beta cells and inhibits insulin secretion. It impacts the insulin axis more than other sympathetic receptors, including beta-2 receptors. The alpha-2 receptor is a Gi protein-coupled receptor.

Somatostatin

Sumo-Santa

Somatostatin is a hormone produced by the delta cells of the pancreas. It can suppress insulin and glucagon release. However, somatostatin suppresses insulin more than glucagon.

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