How tyrosine might help regulate glucose levels

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Video Abstract

Keywords: dopamine, glucose homeostasis, glucose-stimulated insulin secretion (GSIS), tyrosine, gut, 3,4-dihydroxy-L-phenylalanine (L-DOPA), anti-incretin, hypoglycemia, postprandial circuit, incretin, beta cell, hyperglycemia, hindgut hypothesis, foregut hypothesis, gastrointestinal tract, Roux-en-Y, gastric bypass, innervation, type 2 diabetes mellitus (T2DM), bariatric surgery

Posted Date: September 20th, 2019

DOI: https://doi.org/10.21203/rs.2.14998/v1

Abstract

New research reveals a previously unrecognized circuit for regulating blood glucose levels. This circuit supports a recently proposed mechanism for why patients undergoing gastric bypass surgery show reduced symptoms of diabetes, well before weight loss. Our bodies turn the carbohydrates, fats and proteins found in food into useful sugars, fatty acids and amino acids. After a meal, the pancreas works to keep our blood sugar level, or glycemia, high enough to keep our brain fed, yet low enough not to damage delicate tissues. It does that by secreting the regulatory hormone insulin. Insulin stimulates the storage of glucose as starch in the liver and muscle. While some amino acids can enhance insulin production, one of them actually does the opposite. Researchers demonstrated that nutritional tyrosine is converted to the neurotransmitter dopamine in the gut and stomach after eating. The release of that dopamine into circulation inhibits insulin secretion from the pancreas, providing a defense against low blood sugar levels. The team showed that compared to one rich in tyrosine, a tyrosine-free meal produced lower levels of circulating dopamine, stronger insulin secretion, and lower glycemia. However, when glucose and tyrosine were ingested together, the release of insulin was lower and glycemia was higher than when glucose alone was given. The researchers confirmed this mechanism by tracking isotopically labeled tyrosine and glucose fed to rodents. For certain patients undergoing bypass surgery, that finding could hold special significance. Roux-en-Y gastric bypass surgery is often performed in overweight patients with type 2 diabetes. This surgery removes much of the stomach and bypasses the upper intestine, limiting the availability of nutrients to promote weight loss. That weight loss reduces the burden of insulin production and is often accompanied by the reversal of hyperglycemia. But how hyperglycemia can disappear before weight loss remained unclear. The new data suggest that the removal of tissue from the stomach and the upper intestine is the basis for reversing hyperglycemia, as these are the exact same tissues responsible for the conversion of tyrosine to dopamine, which inhibits insulin secretion. Removing that insulin stopgap therefore results in more insulin production and lower blood glucose levels. More work is needed to refine the physiology of gut dopamine and insulin secretion. Nevertheless, the findings could be enough proof that the proposed circuit actually exists, which could provide clinicians with druggable targets and dietary guidelines for regulating glycemia in patients.