

Blood Glucose Regulation

Blood glucose regulation is a crucial process to maintain homeostasis in the body. Glucose is the primary energy source for cells, and its regulation is essential to prevent the development of various metabolic and systemic diseases. Here, we explore how these hormones function and their implications for health.

The human body keeps blood glucose levels within a narrow range, generally between 70 and 100 mg/dL while fasting. To adjust to glucose fluctuations that occur after eating (increase in glucose) or during exercise and fasting (decrease in glucose), the pancreas secretes two key hormones: insulin and glucagon.

Insulin

Insulin is an anabolic hormone, meaning it promotes energy storage in the body. It is produced and released by the beta cells in the islets of Langerhans in the pancreas when blood glucose levels rise, as happens after eating.

• Effects of insulin:

- Decreases blood glucose levels by allowing cells to absorb glucose for energy use.
- Stimulates the storage of glucose in the form of glycogen in the liver and muscles.
- Promotes protein and fat synthesis, favoring energy storage.
- Inhibits glucose production in the liver, preventing the body from releasing more glucose into the bloodstream.

Glucagon

Glucagon is a catabolic hormone, meaning it promotes the breakdown of stored molecules to release energy. It is secreted by the alpha cells in the islets of Langerhans in the pancreas when blood glucose levels are low, as in fasting or between meals.

• Effects of glucagon:

- Increases blood glucose levels by stimulating the release of stored glycogen in the liver.
- Stimulates gluconeogenesis, a process in which the body produces glucose from other sources, such as proteins and fats.
- Promotes the release of fatty acids from adipose tissue to be used as energy, helping to conserve glucose for vital functions.

Balance Between Insulin and Glucagon

The balance between these two hormones ensures that blood glucose levels remain within an optimal range. When glucose levels are high (after eating), insulin facilitates glucose absorption and storage. On the other hand, when glucose levels are low (during fasting or exercise), glucagon stimulates the release of stored glucose, ensuring the body continues to function correctly.

Critical Glucose Levels

The body must maintain glucose within healthy ranges to avoid complications. Here are the critical levels for blood glucose:

1. 4 grams of glucose in the blood (70-100 mg/dL): This is the healthy, normal range for blood glucose, allowing the body to function efficiently.
2. 4.1 grams of glucose in the blood: If blood glucose levels remain above this threshold, even by just 0.1, it can cause diabetic coma due to hyperglycemia.
3. 3.9 grams of glucose in the blood: A glucose level lower than this threshold can cause diabetic coma due to hypoglycemia.

Consequences of Inadequate Glucose Regulation

When glucose regulation doesn't function properly, various disorders can arise that affect long-term health. Some of the main conditions associated with dysfunctional glucose regulation include:

1. **Insulin Resistance:** This occurs when the body's cells do not respond adequately to insulin. As a result, the pancreas releases more insulin to try to reduce glucose levels, but over time, this process may not be sufficient, increasing the risk of developing type 2 diabetes.
2. **Type 2 Diabetes:** In this condition, the body cannot use insulin effectively or does not produce enough insulin. This leads to elevated blood glucose levels, which increases the risk of serious complications such as cardiovascular diseases, kidney damage, neuropathies, and eye problems.
3. **Fatty Liver:** Excess glucose in the blood can be converted into fat, which is stored in the liver, leading to a condition known as non-alcoholic fatty liver disease.
4. **Weight Gain and Obesity:** Glucose not used as energy is converted into body fat. This contributes to weight gain and increases the risk of developing obesity, which in turn favors the onset of metabolic diseases.
5. **Mood Changes and Cognitive Problems:** Fluctuations in glucose levels can affect brain function, leading to mood changes and difficulties concentrating. Over time, these changes can contribute to cognitive problems and increase the risk of dementia.
6. **Polycystic Ovary Syndrome (PCOS):** In women, insulin resistance is linked to polycystic ovary syndrome, which can cause menstrual irregularities, difficulty conceiving, and a higher risk of developing type 2 diabetes.

Conclusion

Maintaining blood glucose levels within a healthy range is essential for the proper functioning of the body and the prevention of chronic diseases. Insulin and glucagon play complementary and fundamental roles in this regulation process. However,

factors such as diet, physical activity, stress, and genetics can interfere with this balance, increasing the risk of developing metabolic disorders like type 2 diabetes, obesity, and cardiovascular diseases.

Adopting a healthy lifestyle (with a balanced diet, regular exercise, and stress management) is crucial to support proper blood glucose regulation. Additionally, regular monitoring of glucose levels can be key, especially for individuals with a family history of diabetes or metabolic diseases, to prevent long-term complications. With proper habits, it is possible to maintain glucose balance and effectively improve metabolic health.