



Clinical Biochemistry

Dr. Mustafa Mohammed & Dr.
Marowa Hashim



Diabetes mellitus

Diabetes mellitus (DM), commonly known as **diabetes**, is a group of metabolic disorders characterized by high blood sugar levels over a prolonged period

Normal Insulin Metabolism

Insulin •

Produced by the β cells in the islets of Langerhans of the pancreas –

Facilitates normal glucose range of 3.9 – 6.7 mmol/L –

Promotes glucose transport from the bloodstream across the cell membrane to the cytoplasm of the cell •

Analogous to a “key” that unlocks the cell door to allow glucose in •

↑ Insulin after a meal: •

Stimulates storage of glucose as glycogen •

Inhibits gluconeogenesis •

Enhances fat deposition in adipose tissue •

Increases protein synthesis

Fasting state •

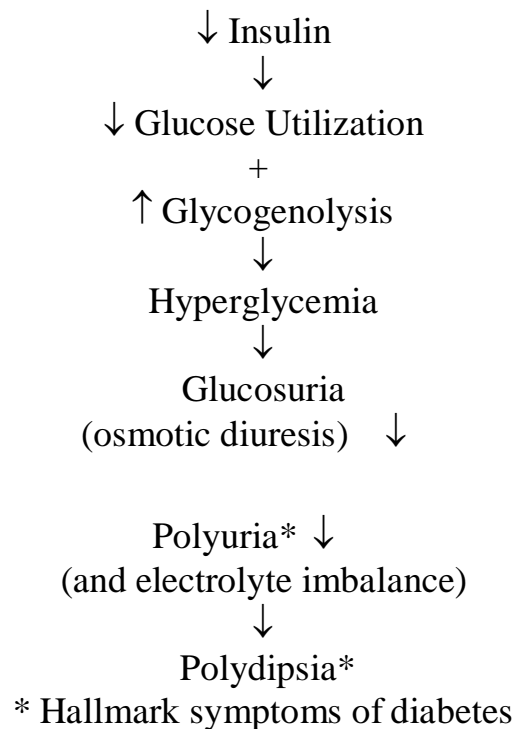
Counter-regulatory hormones (especially glucagon) stimulate glycogen → glucose –

When glucose unavailable during fasting state •

Lipolysis (fat breakdown) –

Proteolysis (amino acid breakdown) –

ALTERED CHO METABOLISM



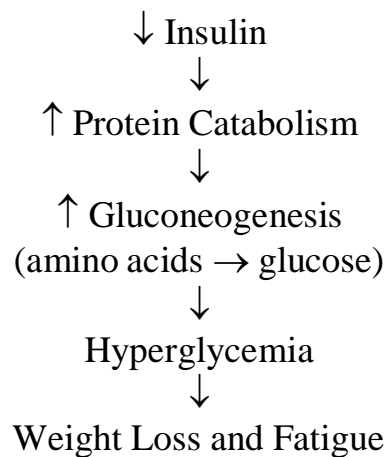
Symptoms of high blood sugar include

Frequent urination, increased thirst, and increased hunger.

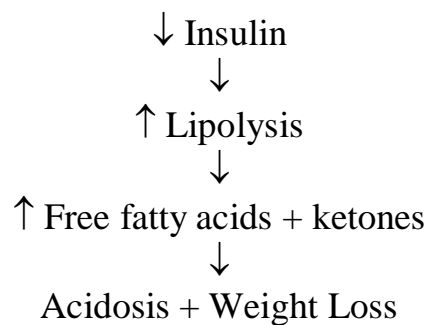
If left untreated, diabetes can cause many complications. Acute complications can include diabetic ketoacidosis, hyperosmolar hyperglycemic state, or death. Serious long-term complications include cardiovascular disease, stroke, chronic kidney disease, foot ulcers, and damage to the eyes.

Diabetes is due to either the pancreas not producing enough insulin, or the cells of the body not responding properly to the insulin produced.

ALTERED PROTEIN METABOLISM



ALTERED FAT METABOLISM



There are three main types of diabetes mellitus:

- Type 1 diabetes results from the pancreas's failure to produce enough insulin due to loss of beta cells. This form was previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The loss of beta cells is caused by an autoimmune response.
- Most often occurs in people under 30 years of age
- Peak onset between ages 11 and 13
- Progressive destruction of pancreatic β cells

- Autoantibodies cause a reduction of 80% to 90% of normal β cell function before manifestations occur
- **Causes:**
- Genetic predisposition
- Exposure to a virus

Onset of Disease

- Weight loss
- Polydipsia (excessive thirst)
- Polyuria (frequent urination)
- Polyphagia (excessive hunger)
- Weakness and fatigue
- Ketoacidosis
- **Diabetic ketoacidosis (DKA)**
 - Life-threatening complication of Type 1 DM
 - Occurs in the absence of insulin
 - Results in metabolic acidosis
- Type 2 diabetes begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses, a lack of insulin may also develop. This form was previously referred to as "non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The most common cause is a combination of excessive body weight and insufficient exercise.
- Accounts for 90% of patients with diabetes
- Usually occurs in people over 40 years old
- 80-90% of patients are overweight
- **Insulin resistance**
 - Body tissues do not respond to insulin
 - Results in hyperglycemia

- **Decreased (but not absent) production of insulin**
- Gradual onset
- Person may go many years with undetected hyperglycemia
- Marked hyperglycemia (27.6 – 55.1 mmol/L)
- **Non-specific symptoms**
- **Fatigue**
- **Recurrent infections**
- **Prolonged wound healing**
- **Visual changes**
- Gestational diabetes is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels.

Develops during pregnancy •

Detected at 24 to 28 weeks of gestation •

Associated with ↑ risk for cesarean delivery, perinatal death, and neonatal complications

Signs and symptoms

The classic symptoms of untreated diabetes are 'weight loss, polyuria (increased urination), polydipsia (increased thirst), and polyphagia (increased hunger). Symptoms may develop rapidly (weeks or months) in type 1 diabetes, while they usually develop much more slowly and may be subtle or absent in type 2 diabetes.

Complications

Diabetic nephropathy

Diabetic retinopathy

Diabetic neuropathy

Secondary Diabetes

Results from another medical condition or due to the treatment of a medical condition that causes abnormal blood glucose levels •

Cushing syndrome (e.g. steroid administration) –

Hyperthyroidism –

Parenteral nutrition

Diagnostic Studies

Fasting plasma glucose level >7 mmol/L •

Random plasma glucose level > 11.1 mmol/L plus symptoms •

Impaired Glucose Tolerance Test – patient is “challenged” with glucose load. •
Patient should be able to maintain normal BG. Diabetes if BG > 11.1 mmol/L 2 hr post challenge

Hemoglobin A1C test (glycosylated Hgb) •

Reflects amount of glucose attached to Hgb over life of RBC –
Indicates overall glucose control over previous 90 – 120 days