

# Pancreas

- Partially locates behind the stomach, between the spleen and the duodenum
- It is both:
  - an exocrine gland: produce digestive enzymes
  - Endocrine gland: produce hormone
- Major disorder of endocrine pancreas: Diabetes Mellitus (DM)
- Endocrine pancreas consists of clusters of cells: Pancreatic islets (Islets of Langerhans) scattered throughout the gland
- Pancreatic hormones are secreted directly into the bloodstream and circulate throughout the body
- 3 main types of cells in pancreatic islets:
  - $\alpha$  (alpha) cells: secrete glucagon, which mobilizes glycogen from the liver and suppresses insulin secretion. Glucagon is critical in maintain blood glucose levels between meals.
  - $\beta$  (beta) cells: secrete insulin (most numerous), promotes glucose utilization
  - $\delta$  (delta) cells: secrete somatostatin and gastrin, which regulates  $\alpha$  and  $\beta$  cells function by suppressing the release of insulin, glucagon, and pancreatic polypeptides

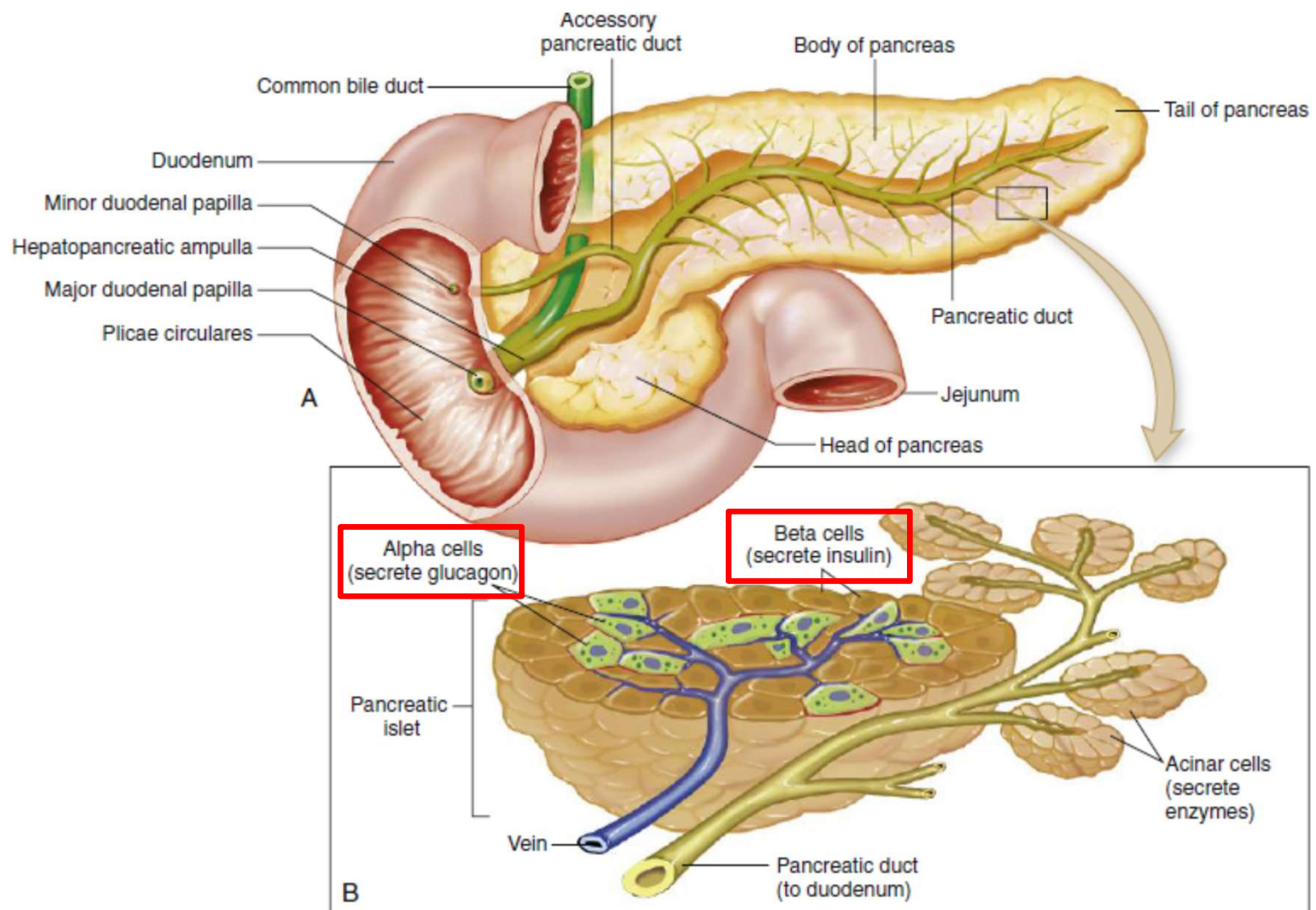


Figure 12: A. The Pancreas B. Exocrine glandular cells and endocrine glandular cells of the pancreatic islets (McCance, Huether, & Brashers, 2014)

# Pancreatic Islets

Normal blood glucose level (Department of Health, 2017):

- Before meal: 4-7 mmol/L
- 2 hours after meal: 8-10 mmol/L

Blood glucose levels are controlled mainly by the opposing action of insulin and glucagon

- Glucagon(升糖素):
  - Major effect: ↑ blood glucose levels by:
    - Conversion of glycogen (糖原) to glucose in the liver and skeletal muscles (glycogenolysis 糖原分解)
    - Increasing conversion of glycogen to glucose
  - Secretion of glucagon is stimulated by low blood glucose levels and exercise
  - It will be decreased by somatostatin(體抑素) and insulin (胰島素)

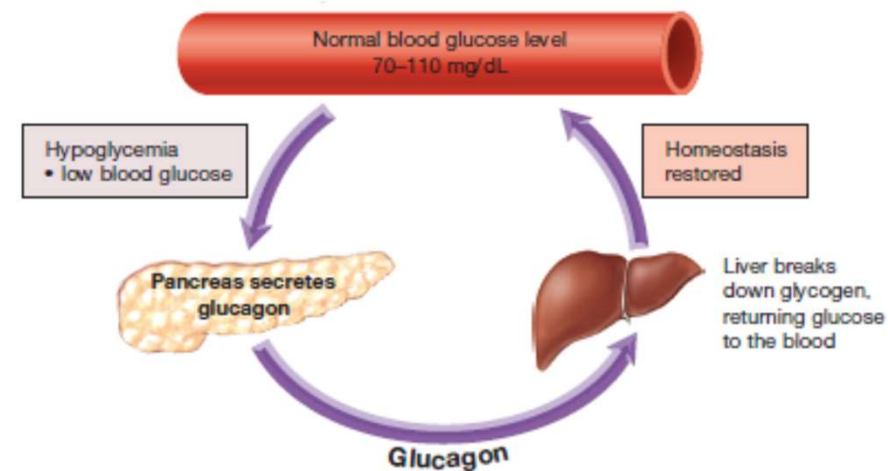


Figure 13: Glucose metabolism during hypoglycemia(Adams, Holland & Urban, 2017)

# Pancreatic Islets

- Insulin:
  - A polypeptide
  - Main function: to lower raised blood nutrient levels, not only glucose but also amino acids and fatty acids
  - Promotes storage of nutrients
  - When nutrients, especially glucose are in excess → insulin promotes storage by:
    - Acting on cell membranes and stimulating uptake and use of glucose by muscle and connective tissue cells
    - ↑ conversion of glucose to glycogen (glycogenesis), especially in liver and skeletal muscles
    - Accelerating uptake of amino acids by cells, and the synthesis of protein
    - Promoting synthesis of fatty acids and storage of fat in adipose tissue (lipogenesis)
    - ↓ glycogenolysis (breakdown of glycogen into glucose)

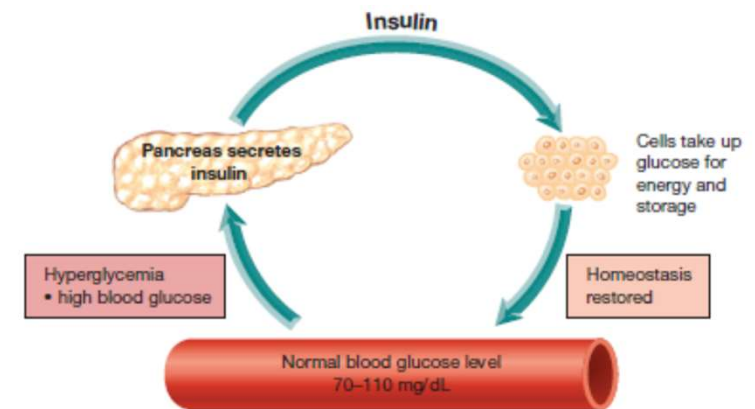


Figure 14: Glucose metabolism during hyperglycemia(Adams, Holland & Urban, 2017)