OCR (B) Biology A-level
5.3.2 - Hormonal control of blood of glucose and management of diabetes

Flashcards

Describe the structure of the pancreas.

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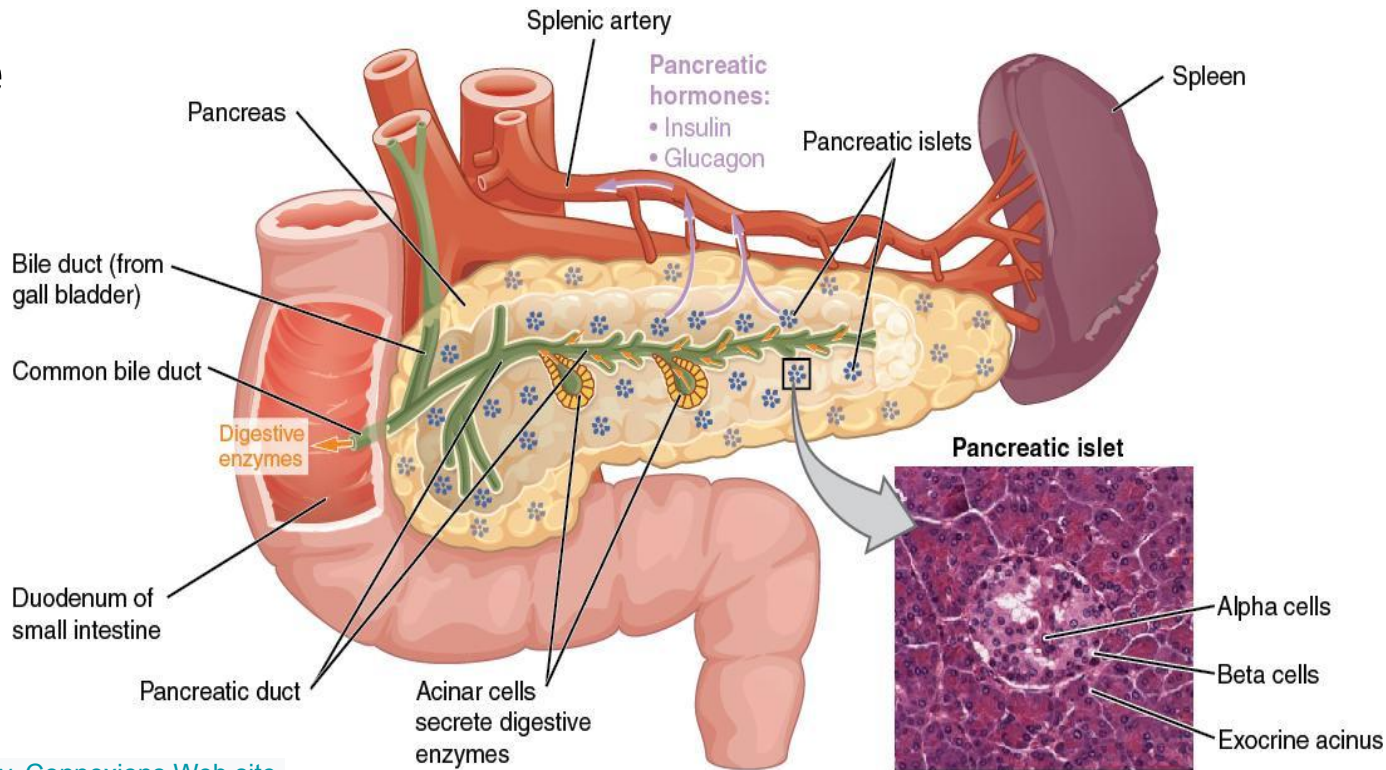
Splenic artery

Pancreatic hormones:
- Insulin
- Glucagon

Spleen

Pancreas

Pancreatic islets

Bile duct (from gall bladder)

Common bile duct

Digestive enzymes

Duodenum of small intestine

Pancreatic duct

Acinar cells secrete digestive enzymes

Pancreatic islet

Alpha cells

Beta cells

Exocrine acinus

List the endocrine and exocrine functions of the pancreas.

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endocrine: secretes the hormones insulin & glucagon

exocrine: secretes digestive enzymes
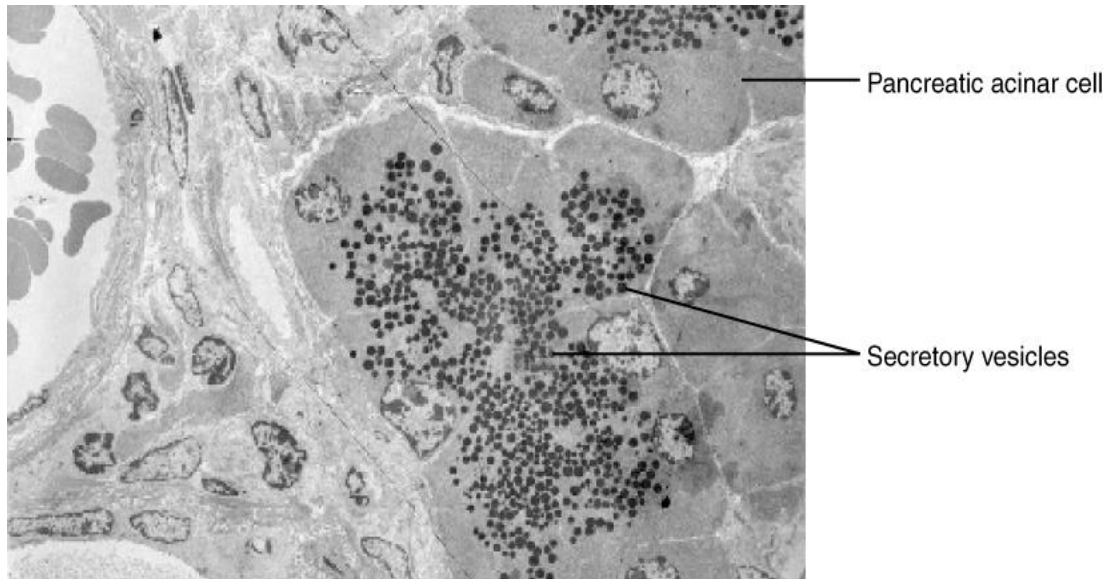

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Why is it important that blood glucose concentration remains stable?

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- To maintain constant **blood water potential**: prevents osmotic lysis/ crenation of cells
- To maintain constant **concentration of respiratory substrate**: organism maintains constant level of activity regardless of environmental conditions

Outline the role of glucagon when blood glucose concentration decreases.

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1. **α cells** in **islets of Langerhans** in **pancreas** detect decrease & secrete **glucagon** into bloodstream.
2. Glucagon binds to surface receptors on **liver** cells & activates enzymes for **glycogenolysis** & **gluconeogenesis**.
3. Glucose diffuses from liver into bloodstream.
4. α cells detect that blood glucose concentration has returned to optimum & stop producing glucagon (negative feedback).

Use the secondary messenger model to explain how glucagon works.

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1. Glucagon/adrenaline binds to receptors on surface membrane of target cell.

2. Hormone-receptor complex forms.

3. Conformational change to receptor activates G-protein.

4. Activates **adenylate cyclase**, which converts ATP to **cyclic AMP** (cAMP).

5. cAMP activates **protein kinase A** pathway.

6. Results in **glycogenolysis**.

Outline what happens when blood glucose concentration increases.

Outline what happens when blood glucose concentration increases.

1. **β cells** in **islets of Langerhans** in **pancreas** detect increase & secrete **insulin** into bloodstream.
2. Insulin binds to surface receptors on target cells to:
   a. increase cellular glucose uptake
   b. activate enzymes for **glycogenesis** (liver & muscles)
   c. stimulate adipose tissue to synthesise fat
3. β cells detect that blood glucose concentration has returned to optimum & stop producing insulin (negative feedback).

Describe how insulin leads to a decrease in blood glucose concentration.

Describe how insulin leads to a decrease in blood glucose concentration.

- Increases permeability of cells to glucose

- Increases glucose concentration gradient

- Triggers inhibition of enzymes involved in glycogenolysis

Explain the causes of and risk factors for Type 1 diabetes.

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Body cannot produce insulin e.g. autoimmune response attacks β cells of islets of Langerhans.

Risk factors:
- human leukocyte antigen (HLA) complex on chromosome 6
- some viral infections e.g. German measles
- ethnicity & family history

Explain the causes of and risk factors for Type 2 diabetes.

Explain the causes of and risk factors for Type 2 diabetes.

Glycoprotein receptors are damaged or become less responsive to insulin.

Strong positive correlation with poor diet/ obesity.

What are common the symptoms of diabetes?

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- Large volume of urine (polyuria)

- Excessive thirst (polydipsia)

- Significant unexplained weight loss

How is diabetes diagnosed?

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Confirmed by at least 1 quantitative test:

- random venous plasma glucose ≥ 11.1 mmol/l

- fasting plasma glucose ≥ 7.0 mmol/l

- fasting whole blood glucose ≥ 6.1 mmol/l

- oral glucose tolerance test: administer 75g anhydrous glucose, 2 hours later plasma glucose ≥ 11.1 mmol/l

How do urine tests identify individuals who may have diabetes?

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Presence of ketones: Ketones form when fats are respired. Indicates that there is insufficient insulin for glucose uptake for respiration.

Presence of microalbumin proteins: Indicates kidney damage. This may be caused by blood vessel damage due to diabetes.

How can biosensors be used to monitor blood glucose concentration?

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A bioreceptor detects the presence of a glucose. A transducer converts the response into a detectable electrical signal.

How can glycosylated haemoglobin concentrations be used to monitor blood glucose control?

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Glycosylation: covalent bond between blood glucose & red blood cells.

Provides an average of blood glucose concentration for the previous 60 days. Can therefore indicate whether treatment has been successful. Healthy patients have values 4.5% - 6.0%.

How are Type 1 and Type 2 diabetes treated?

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Type 1: Treat by injecting insulin from animal source or genetically modified bacteria. Possible future treatment: use stem cells to produce new β cells.

Type 2: Treat by controlling diet and exercise regime.

Describe the team of health professionals involved in managing diabetes.

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- **Diabetes nurses**: promote self-care, monitor test readings & mental wellbeing, refer patients to specialist services
- **Dieticians**: provide evidence-based diet advice e.g. on carbohydrate counting
- **Retinal screeners**: test for damage to blood vessels in the retina
- **Podiatrists**: aim to prevent foot ulcers/ infections caused by nerve damage & poor circulation

How might diabetes affect the human population in the future?

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Number of individuals with diabetes is expected to double in the next 25 years, mainly due to lifestyle factors linked to Type 2 diabetes.

Related costs will increase proportionally (expensive to provide care for chronic illness). Therefore, current interventions focus on reducing Type 2 diabetes risk in population.