6.4 Endocrine pancreas

The pancreas is an organ in the abdomen; it has both exocrine and endocrine functions. It secretes several hormones, including insulin which is needed for normal glucose, fat and protein metabolism. Reduced or absent action of insulin characterises diabetes mellitus.

6.4.1 Structure and function

The pancreas lies retroperitoneally in the abdomen and is located posterior to the stomach. In addition to having an endocrine role, it is an exocrine gland due to its role in digestion (see *Section 7.10.2*).

Interspersed between the pancreatic exocrine glands are clusters of endocrine cells: the **islets of Langerhans** (**Figure 6.11**). These are composed of three main cell types, each secreting a different peptide hormone (**Table 6.2**). The β cells are located at the centre of islets and are much more numerous than the peripheral α cells.

α Cells

These cells secrete glucagon in response to hypoglycaemia and in the fasting state. Glucagon is a catabolic hormone, i.e. a hormone that promotes breakdown of large molecules into smaller ones. It is one of the main hormones signalling hepatic breakdown of glycogen to glucose, thereby antagonising the action of insulin and helping to maintain an energy supply during fasting (see *Chapter 7* for further details on post-prandial and fasting states).

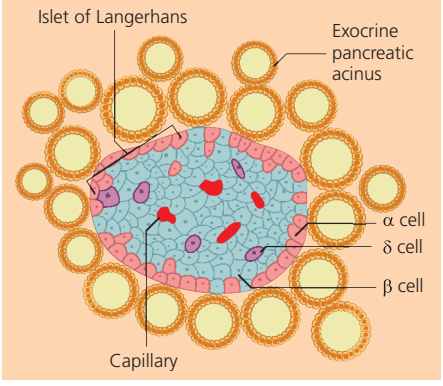

Figure 6.11 Histology of the pancreas. Islets of Langerhans are surrounded by exocrine pancreatic tissue. The blood flows from the centre of the islet out to the periphery.

Glucagonoma

Tumours of pancreatic α cells are relatively rare, but they can present insidiously with excess glucagon production. Typically, they are found in elderly men who suddenly develop type 2 diabetes but show weight loss rather than obesity. The excess glucagon promotes hyperglycaemia, but as there is no insulin deficiency, patients do not develop ketoacidosis (only a small amount of insulin is needed to stop ketone production). A severe, progressive skin rash also suggests that a tumour is present. If the tumour is surgically removed, 85% of patients survive at 5 years.

Table 6.2 *Hormones produced by the islets of Langerhans and their mechanisms of action*

Cell	Hormone	Receptor type	Secondary messenger	Function
α Cell	Glucagon	Tyrosine kinase	Insulin receptor substrates	Anabolism, lowers blood glucose
β Cell	Insulin	G-protein-coupled receptor	$G_s \rightarrow$ AC $\rightarrow$ increase cAMP, and $PIP_2 \rightarrow$ increase Ca^{2+}	Catabolism, raises blood glucose
δ Cell	Somatostatin	G-protein-coupled receptor	$G_i \rightarrow$ AC $\rightarrow$ reduced cAMP	Suppression of multiple hormones, e.g. vasoactive intestinal peptide, gastrin