STRUCTURE OF ENDOCRINE PANCREAS

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GROSS STRUCTURE OF PANCREAS
DEVELOPMENT OF PANCREAS

- **3rd month**
  - Pancreatic islets (of Langerhans) develop from parenchymatous pancreatic tissue between 9-12 weeks
  - Scatter throughout pancreas

- **5th month**
  - Insulin secretion starts
a Duodenum and pancreas, anterior view

b Pancreatic acinus

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PANCREATIC ISLETS

- Islets (of Langerhans) ~ 1-2% volume of pancreas
- Islets spread among exocrine tissue
- > 1 million islets in human pancreas
- More abundant in tail
- Spherical or ellipsoid (or egg-shaped) clusters of cells
- 100-200 μm in diameter
- Polygonal cells
- Fenestrated capillaries
- Rich autonomic innervation
ULTRASTRUCTURE OF ISLETS

- A / α CELLS
- B / β CELLS
- D / δ CELLS
- F / PP CELLS
- EC CELLS
- D1 CELLS
<table>
<thead>
<tr>
<th>SPECIAL STAIN</th>
<th>A / α CELLS</th>
<th>B / β CELLS</th>
<th>D / δ CELLS</th>
<th>F / PP CELLS</th>
<th>EC CELLS</th>
<th>D1 CELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAIN</td>
<td>Red</td>
<td>Brownish Orange</td>
<td>Blue</td>
<td>Unstained</td>
<td>Unstained</td>
<td>Unstained</td>
</tr>
<tr>
<td>PROPORTION</td>
<td>15-20 %</td>
<td>70 %</td>
<td>5-10 %</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCATION</td>
<td>Peripheri</td>
<td>Central</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>SECRETION</td>
<td>Glucagon, GIP, CCK, ACTH-endorphin, Gastrin</td>
<td>Insulin</td>
<td>Somatostatin</td>
<td>Pancreatic polypeptide</td>
<td>Secretin, Motilin, Substance P</td>
<td>VIP</td>
</tr>
<tr>
<td>WEIGHT (DALTONS)</td>
<td>3500</td>
<td>5700-6000</td>
<td>1638</td>
<td>4200</td>
<td>-</td>
<td>3300</td>
</tr>
<tr>
<td>NATURE OF SECRETION</td>
<td>Linear polypeptide</td>
<td>Dimer of α and β chains with S-S bridges</td>
<td>Cyclic polypeptide</td>
<td>Linear polypeptide</td>
<td>-</td>
<td>Linear polypeptide</td>
</tr>
<tr>
<td>SECRETORY GRANULES</td>
<td>250 nm ~ dense core</td>
<td>300 nm ~ dense crystalline</td>
<td>325 nm ~ medium electron dense</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FUNCTIONS</td>
<td>↑ blood glucose, Lipolysis</td>
<td>↓ blood glucose</td>
<td>Paracrine action</td>
<td>-</td>
<td>Counterpart of EC cells in GIT mucosa</td>
<td>-</td>
</tr>
</tbody>
</table>
ISLET CELLS OTHER THAN B CELLS, ARE COUNTERPARTS OF THE ENTEROENDOCRINE CELLS OF GIT MUCOSA
CONTROL OF PANCREATIC SECRETION

↑ INSULIN SECRETION
• Blood glucose levels > 70 mg/dL
• Some amino acids
• ↑ in blood fatty acids
• Parasympathetic stimulation

↑ GLUCAGON SECRETION
• Blood glucose levels < 70 mg/dL
• Low levels of fatty acids
• Sympathetic & Parasympathetic stimulation
NERVE SUPPLY OF ENDOCRINE PANCREAS

10% of islet cells have nerve endings

- ↑ Glucagon secretion
- ↓ Insulin secretion

- ↑ Glucagon secretion
- ↑ Insulin secretion

Well developed gap junctions between islet cells

Ionic events by synaptic transmitters at nerve endings carried from cell to cell across junctions
BLOOD SUPPLY OF ENDOCRINE PANCREAS

Several Arterioles enter the Periphery of Islets

Branch into Fenestrated Capillaries

First perfuse A & D cells

Traverse septa, then perfuse B cells in the Central portion

Large Efferent Arterioles

Branch into Capillary networks that surround the Acini of Exocrine Pancreas

Cascading Flow resembles Portal System of other Endocrine Glands

Regulatory Effects on Acinar Cells
INSULIN, VIP, CCK STIMULATE EXOCRINE SECRETION

GLUCAGON, PP & SOMATOSTATIN INHIBIT EXOCRINE SECRETION

SECRETIONS OF ISLET CELLS HAVE REGULATORY EFFECTS ON SECRETIONS OF ACINI OF EXOCRINE PANCREAS
INSULIN-DEPENDENT / TYPE I DIABETES (JUVENILE DIABETES): Autoimmune, Antibodies against B cells ~ Depress cells activity

INSULIN-INDEPENDENT DIABETES OR TYPE 2 DIABETES: Occurs later in life, results from a failure of cells to respond to insulin, & is frequently associated with obesity

↑ LEVELS OF PROINSULIN:
- Production of structurally abnormal proinsulin
- Production of normal proinsulin but defective enzyme

DEFICIENCY OF MICROTUBULBULES: B cells synthesize normal amount of insulin, Deficiency of microtubules ~ Hormone not secreted
**Pancreatic Tumors**

- Release insulin, glucagon, somatostatin & PP

- Some tumors produce 2/ more of these hormones generating complex symptoms

**Diagram**

1. Pancreatic Islet Tumor
   - ↑ amount of Gastrin production
   - ↑ Acid production in the Stomach
   - Zollinger Ellison Syndrome
REFERENCES:

- Gray’s Anatomy, 40th Edition
- Basic Histology Text & Atlas, By Luiz Carlos Junqueira & Josã© Carneiro, 12th Edition
SUMMARY OF ID POINTS FOR ENDOCRINOLOGY SECTION

Hypothalamus
- Antidiuretic hormone (ADH)
- Oxytocin (OT)
- Regulatory hormones

Pituitary gland
- Anterior pituitary secretes:
  - Adrenocorticotropic hormone (ACTH)
  - Follicle-stimulating hormone (FSH)
  - Growth hormone (GH)
  - Luteinizing hormone (LH)
  - Melanocyte-stimulating hormone (MSH)
  - Prolactin (PRL)
  - Thyroid-stimulating hormone (TSH)
- Posterior pituitary releases:
  - Antidiuretic hormone (ADH)
  - Oxytocin (OT)

Thyroid gland
- Calcitonin (CT)
- Thyroid hormone (TH)

Thymus
- Thymopoietin
- Thymosins

Parathyroid glands
- Located on posterior surface of thyroid
- Parathyroid hormone (PTH)

Gastrointestinal (GI) tract
- Cholecystokinin (CCK)
- Gastric inhibitory peptide (GIP)
- Gastrin
- Secretin
- Vasoactive intestinal peptide (VIP)

Pancreatic islets
- Glucagon
- Insulin
- Somatostatin
- Pancreatic polypeptide

(Heart)
- Aniopeptin

Adrenal glands
- Cortex:
  - Corticosteroids
- Medulla:
  - Epinephrine (E)
  - Norepinephrine (NE)

(Kidney)
- Calcitriol
- Erythropoietin (EPO)
- Renin
ID POINTS FOR PITUITARY

**PITUITARY GLAND**

- **Anterior Lobe:** Cords of glandular cells separated by sinusoids
- **Intermediate lobe:** Colloid filled vesicles
- **Posterior lobe:** Nerve fibers, pituicytes, capillaries
THYROID GLAND

ID POINTS

- Follicles with pink colloid
- Simple columnar epithelium lining of follicles
- Interfollicular stroma with parafollicular cells
- Numerous capillaries

ID POINTS FOR THYROID
ID POINTS FOR PARATHYROID

PARATHYROID GLAND

ID POINTS

- Anastomosing cords of chief cells
- Oxyphil cells
- Connective tissue septa forming incomplete lobules
ID POINTS FOR ADRENAL

ADRENAL GLAND

ID POINTS

- Adrenal Cortex: Zones of cortex (glomerulosa, fasiculata, reticularis)

- Adrenal Medulla: Irregular groups of cells with blood vessels
ID POINTS FOR PANCREAS

PANCREAS

ID POINTS

- Pancreatic serous acini
- Islets of Langerhans