Morphology of the Endocrine Glands
Lecture Objectives

• Review differences between endocrine and exocrine glands.

• List the endocrine glands.

• Describe the **structure** of endocrine glands.

• Describe the **location, relation, blood and nerve supply** and **lymphatic drainage** of endocrine glands.
Endocrine Vs Nervous Systems

Endocrine and nervous systems work together

<table>
<thead>
<tr>
<th></th>
<th>Nervous System</th>
<th>Endocrine System</th>
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</thead>
<tbody>
<tr>
<td><strong>Speed of action</strong></td>
<td>React quickly (milliseconds)</td>
<td>sustained regulation (take hours, but last longer)</td>
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<td><strong>Pathway</strong></td>
<td>Action potential (from cell to cell)</td>
<td>Circulation of the blood (affect target cells by binding to specific receptors)</td>
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<td><strong>Chemical signals</strong></td>
<td>Neurotransmitters</td>
<td>Hormones</td>
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<tr>
<td><strong>Function</strong></td>
<td>Sensation, movement, and cognition (needs precision and speed of synaptic contacts)</td>
<td>Homeostasis, growth and development, and reproduction</td>
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Endocrine Vs Exocrine Glands

• **Exocrine glands**
  • secrete products into ducts which empty into body cavities or body surface
  • sweat, oil, mucous, & digestive glands

• **Endocrine glands**
  • secrete products (hormones) into bloodstream
    • pituitary, thyroid, parathyroid, adrenal, pineal
  • other organs secrete hormones as a 2nd function
    • hypothalamus, thymus, pancreas, ovaries, testes, kidneys, stomach, liver, small intestine, skin, heart & placenta
The Endocrine System

- Pituitary gland
- Thyroid gland
- Parathyroid glands
- Adrenal glands
- Pancreas
Hypothalamus and Pituitary Gland

• Both are master endocrine glands since their hormones control other endocrine glands

• Hypothalamus is a section of brain above where pituitary gland is suspended from stalk
• Pea-shaped, 1/2 inch gland found in sella turcica of sphenoid
• Infundibulum attaches it to brain
• Anterior lobe = 75% develops from roof of mouth
• Posterior lobe = 25%
  • ends of axons of 10,000 neurons found in hypothalamus
  • neuroglial cells called pituicytes
Pituitary Gland: Structure

- The pituitary is composed of two distinct lobes
  - The anterior lobe or adenohypophysis (pars distalis, pars tuberalis and pars intermedia)
  - The posterior lobe or neurohypophysis (pars nervosa, infundibular stalk or stem and median eminence)
Sella Turcica

(A) Superior view, internal surface of cranial base

† Collectively form sella turcica
* Form crescent of four foramina
Pituitary Gland: Relations

- Sella turcica
- Optic chiasm
- Diaphragma sellae
- Cavernous sinus
  - Content
Pituitary Gland: Relations
Blood supply to pituitary gland

- **Internal carotid artery**
- **Superior Hypophysial artery** for anterior pituitary gland
- **Inferior Hypophysial artery** for Posterior pituitary gland
Flow of Blood to Anterior Pituitary (hypophyseal portal system)

- Controlling hormones enter blood at primary capillary bed
- Travel through portal veins
- Enter anterior pituitary at secondary capillary bed
Flow of Blood to Posterior Pituitary
Posterior Pituitary Gland (Neurohypophysis)

- Does not synthesize hormones
- Consists of axon terminals of hypothalamic neurons
- Neurons release two neurotransmitters that enter capillaries
  - antidiuretic hormone
  - oxytocin
Figure 24-5  Importance of the pituitary gland in controlling other endocrine glands and tissues in the body. The hormones secreted by the different parts of the pituitary gland in exerting this control are indicated.
Thyroid Gland

- Largest endocrine gland in the body
- Location
  - Cervical region anteriorly
- Structure
  - Two lobes
  - Isthmus
  - Pyramidal lobe
- Secretes two hormones
  - Thyroid hormone (thyroxin & triiodothyronine)
    - Increase tissue metabolism
  - Calcitonin
    - Lowers blood calcium
Thyroid Gland: Parts

- **Two lobes of thyroid** on each side of trachea
  - Pyramidal shape with superior apex
  - Extend from lower edge of thyroid cartilage to the fifth tracheal ring
    - C5-T1 vertebrae
- **Isthmus** connects lobes
  - Extend from 2nd to 4th tracheal rings
- **Pyramidal lobe**
  - Mostly found extending upward from the isthmus
Thyroid Gland: Attachments

• Connective tissue capsule surrounds thyroid gland
  • From which connective tissue septa extend into the gland
  • CT attaches the capsule to the cricoid cartilage & tracheal rings

• The visceral part of the pretracheal fascia surrounds the thyroid gland and attaches it to the trachea and larynx
  • Called Capsule of pretracheal fascia or sheath of thyroid gland
Thyroid Gland: Attachments

• Fibromuscular band
  • Connects the pyramidal lobe with the hyoid bone
• Levator glandulae thyroideae
Thyroid Gland: Relations

- Anterolaterally
  - Muscles ...
- Posterolaterally
  - Carotid sheath
    - Content..
- Medially
  - Viscera...
  - Recurrent laryngeal n.
Thyroid Gland: Blood Supply

Arteries
- **Superior thyroid artery** from external carotid
- **Inferior thyroid artery** from thyrocervical trunk
- **Thyroidea ima** (present in 10% of people) from brachiocephalic a.

- Arteries supplying thyroid gland anastomose with each other
- Relation with nerves
  - External laryngeal n.
  - Recurrent laryngeal n.
Thyroid Gland: Blood Supply

Veins

- **Superior thyroid vein** drain into internal jugular vein
- **Middle thyroid vein** drains into internal jugular or inferior thyroid
- **Inferior thyroid vein** drains into the left brachiocephalic vein
Thyroid Gland: Lymphatic Drainage

• Prelaryngeal → deep cervical
• Pretracheal → Paratracheal → deep cervical
• Paratracheal → deep cervical
• Deep cervical
Thyroid Gland: Innervation

- Sympathetic trunk
  - Superior, middle, & inferior cervical ganglia
  - Controls blood flow
- Parasympathetic?
- Regulation through pituitary
Thyroid Gland: Surface Anatomy

- Hyoid bone – C3
  - Posterior to the mandible
- Laryngeal prominence (Adam’s apple)- tip (C4)
- Cricoid cartilage – C6
  - Cricothyroid ligament
- First tracheal cartilage
- Thyroid gland
  - Isthmus – 2\textsuperscript{nd} – 4\textsuperscript{th} tracheal rings
  - Lobe C5-T1
Development of Thyroid Gland

- Develop from an endodermal thickening at the ventral midline between arch I & II
  - Thyroid diverticulum
    - At foramen cecum
    - Migrate caudally
  - Thyroglossal duct
    - Path of migration
    - Obliterate and disappear
  - Adult position

![4 Weeks and 7 Weeks Diagram]
Thyroid Gland Anomalies

- Remnants of thyroglossal duct
  - Aberrant thyroid tissue
  - Thyroglossal duct cysts
  - Pyramidal lobe
Parathyroid Glands

- Small, oval endocrine glands
- Usually four glands (two superior & two inferior)
- Secretes parathyroid hormone (parathormone)
  - Elevates blood calcium levels
Parathyroid Gland: Location

- Lie on the posterior aspect of the lateral lobes of the thyroid gland
- Superior glands
  - Lower edge of cricoid cartilage
  - Middle of the thyroid gland
- Inferior glands
  - Lower pole of the thyroid gland
Parathyroid Glands: Attachments

- Surrounded by a connective tissue capsule with septa dividing it into irregular lobes
- Lies external to the thyroid gland capsule
- Surrounded by the thyroid gland sheath
Parathyroid Glands: Blood Supply

• Arteries
  • Inferior thyroid a.
  • Superior thyroid a.

• Veins
  • Middle thyroid v.
  • Inferior thyroid v.
Parathyroid Glands

• Lymphatic drainage
  • Paratracheal → deep cervical
  • Deep cervical

• Nerve supply
  • middle, & inferior sympathetic cervical ganglia
• One on top of each kidney
  • Right adrenal gland
    • Pyramidal in shape
  • Left adrenal gland
    • Crescent in shape
• Retroperitoneal organs
• 3 x 3 x 1 cm in size and weighs 5 grams
• Surrounded by renal fascia
• Separated from kidneys by the perirenal fat
Relations of adrenal glands

Figure 24-15  Structures situated on the posterior abdominal wall behind the stomach. Note the position of the suprarenal glands.
Structure of Adrenal Gland

- Cortex derived from mesoderm
- Medulla derived from ectoderm
Histology of Adrenal Gland

- Cortex
- 3 zones
- Medulla

• Capsule
  Zona glomerulosa secretes mineralocorticoids, mainly aldosterone

• Adrenal cortex
  Zona fasciculata secretes glucocorticoids, mainly cortisol

• Zona reticularis secretes androgens, mainly dehydroepiandrosterone (DHEA)

• Adrenal medulla chromaffin cells secrete epinephrine and norepinephrine (NE)
Adrenal Medulla

- Chromaffin cells receive direct innervation from sympathetic nervous system
  - sympathetic preganglionic axons pass, without synapsing, through the sympathetic trunk, greater splanchnic nerves and celiac ganglion into the adrenal medulla
  - develop from same tissue as postganglionic neurons
- Produce epinephrine & norepinephrine
- Hormones are sympathomimetic
  - effects mimic those of sympathetic NS
  - cause fight-flight behavior
- Acetylcholine increase hormone secretion by adrenal medulla
Blood Supply to the Adrenal Gland

Arteries
• Inferior phrenic artery from aorta
• Aorta
• Renal artery

Veins
• Right suprarenal vein – IVC
• Left suprarenal vein – left renal vein
Blood Supply to the Adrenal Glands

- blood enters from **capsular arteries** which form **capillary plexuses** in the zona glomerulosa and **sinusoids** in the zona fasciculata.

- The sinusoids branch again to form **capillary plexuses** in the zona reticularis and medulla.

- This system is similar to that of the pituitary gland in that the blood that enters the medulla carries hormones secreted by the cortical cells.
Pancreas

- Soft and lobulated mixed gland
- Retroperitoneal organ
- Elongated organ (5 in) located in the upper part of the abdomen
- Cells (99%) acini produce digestive enzymes
- Endocrine cells in pancreatic islets (islets of Langerhans) produce hormones
  - Found more in the tail
Cell Organization in Pancreas

- Exocrine acinar cells surround a small duct
- Endocrine cells secrete near a capillary
Histology of the Pancreas

- 1 to 2 million pancreatic islets
- Contains 4 types of endocrine cells
Cell Types in the Pancreatic Islets

- Alpha cells (20%) produce glucagon
- Beta cells (70%) produce insulin
- Delta cells (5%) produce somatostatin
- F cells produce pancreatic polypeptide
Pancreas: Parts

- Head
  - Surrounded by the duodenum
  - Uncinate process
    - Posterior to the superior mesenteric BVs
- Neck
  - Anterior to superior mesenteric a.
- Body
  - Cross the medline to the left
- Tail
  - Reach the spleen in splenicorenal ligament
Pancreatic Ducts

- **Main pancreatic duct**
  - Runs through the length of the pancreas
  - Connect to the bile duct
  - Empty in the 2nd part of the duodenum
    - Major duodenal papilla
- **Accessory pancreatic duct**
  - Not always present
  - Sometimes connect to the main duct
  - Drains upper part of the head
  - Empty in the duodenum above the main duct
    - Minor duodenal papilla
Figure 24-15  Structures situated on the posterior abdominal wall behind the stomach. Note the position of the suprarenal glands.
Pancreas

- **Blood supply**
  - Splenic BVs
  - Superior & inferior pancreaticoduodenal BVs

- **Lymph drainage**
  - Celiac & superior mesenteric lymph nodes

- **Nerve supply**
  - Celiac & superior mesenteric plexuses