Exercise 8
Endocrine System

Objectives

After completing this exercise you should be able to

- Identify various endocrine organs in light microscopic sections
- Identify the major divisions and subdivisions of the pituitary gland.
- Identify the neurohypophysis.
- Identify the thyroid and parathyroid glands and the cell types in each
- Identify the adrenal glands of mammals
- Identify the endocrine portions of the pancreas
- Identify the pineal body

Introduction

Endocrine organs are glands whose products are secreted into the blood, to affect tissues distant from
the site of secretion. These secretory products are hormones. Because endocrine organs secrete directly
into the blood they haven't got the elaborate duct system exocrine glands have. Histologically they tend to
be quite uniform in structure: masses of cells with blood vessels running through them. It's been said that
endocrine physiology is definitive proof that the Universe is not rationally ordered, and anyone who's spent
time trying to unravel its subtleties recognizes the kernel of truth in that wry remark. But some
understanding of the structure of the organs of the system gives insight into their relationship to each other,
and to the brain, which runs the whole show.

- Most endocrine organs are "epithelial" and would of course therefore be categorized as glandular
  epithelium

Pituitary Gland

We'll start with the pituitary gland, widely referred to as the "Master gland" because its hormonal
secretions have as their target organs other endocrine glands.

The pituitary gland arises from two different embryonic rudiments: one is a depression in the floor of
the forming brain and the other is an evagination of the dorsal surface of the forming gut. Consequently, in
the finished state, this organ had two parts that are distinctly different in appearance and in nature.

The adenohypophysis (anterior pituitary) is that portion of the gland that comes from the gut: it is
epithelial in nature. The root word "adeno" implies its origin from epithelium, not neural tissue. The mature
adenohypophysis has several distinct parts: the cranial pars distalis, the pars intermedia which is
physically associated with the neural rudiment, and the pars tuberalis, which comes to form a sort of
sleeve-like covering of the stalk from which the neural portion is dependent.

The neurohypophysis (posterior pituitary) is that part of the organ derived from the brain, and unlike
the adenohypophysis, it retains its connection to the tissue of origin, via a long stalk. The neurohypophysis
has a lumen, and that lumen is continuous with the lumen of the brain's third ventricle. The lumen of the
neurohypophysis, like the ventricles of the brain, is lined by ependymal cells. This part of the pituitary
gland, in an anatomic sense, may be considered a part of the brain, and its histologic appearance confirms
this. It consists mainly of nerve fibers with associated glial elements. It is a dependent part of the median
eminence of the hypothalamus.

Microscopic Anatomy of the Pituitary

The most prominent area of the pituitary, consisting of a uniform mass of relatively basophilic cells, is
the pars distalis. There may be a space or cleft next to it (this is the residual lumen of the gut rudiment)
and on the opposite side of the cleft you should be able to see the narrow region of the pars intermedia.

The cells of the pars distalis can be characterized as acidophilic and basophilic types, easily identified
by their staining reactions. A third population that appears to be unstained is present; these are probably
basophils that have discharged their hormones. The acidophils produce growth hormone and prolactin; the
basophils produce thyroid stimulating hormone, adrenocorticotropic hormone, and gonadotrophic hormones.

The pars intermedia is pressed up close to the neurophysys. It too is an epithelial area, but its staining reaction is distinctly different from the pars distalis. There are normally no acidophilic cells obvious in it. The arrangement of the cords and sinuses is somewhat different too, and you should have no trouble telling this region from the pars distalis. However, the pars intermedia grades into the pars tuberalis without a definite boundary.

The pars nervosa with a long and narrow lumen to it arises as a ventral outpouching of the floor of the brain, and it retains its connection with the brain. The lining cells of the pars nervosa are the same sort of ependymal cells found lining the central nervous system. If you have a favorable section, you may be able to trace the connection between the space in the pars nervosa and the brain ventricle.

Remember that the pars nervosa neural tissue consist mainly of axons whose cells bodies are located in the hypothalamus. Unlike most other axons, these don’t form synapses with other neurons.

List of slides – Pituitary

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<tr>
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<td>Human</td>
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<td>EN-2</td>
<td>Human</td>
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<td>EN-3</td>
<td>Mammal</td>
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<td>EN-4</td>
<td>Kitten</td>
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REVIEW BOX SLIDE 99

Pineal Gland

Grossly the pineal gland is a sort of cone shaped structure projecting from the roof of the midbrain. Histologically about 95% of the cells are pinealocytes, the functional cells which synthesize melatonin. These cells are large and lightly stained in H & E, with a rounded nucleus. The remaining cells are astrocytes, which can not be seen on an H & E stained slide.

List of slides – Pineal gland

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<tr>
<td>EN-30</td>
<td>Mammal</td>
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<td>EN-31</td>
<td>Human</td>
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REVIEW BOX SLIDE 100

Endocrine Pancreas

The endocrine pancreas is distributed through the mass of the organ as "islands" of lighter staining material. These pancreatic islets are easily seen at low power. At higher magnification several characteristics of the islets can be seen.

Islet are more or less set off from the surrounding exocrine tissue by a thin "capsule" of CT. They're extensively vascularized, much more so than the surrounding exocrine issue: an islet is essentially a capillary bed surrounded by secretory cells.

The cells of the islets are not easily distinguished from one another in H & E preparations, but there are 4 types known to exist. The principal ones are the A and B cells; the A cells make glucagon and the B cells make insulin. These two antagonistic hormones are vital to normal carbohydrate metabolism.

List of slides – Endocrine pancreas

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<tr>
<td>EN-16</td>
<td>Cat</td>
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<td>EN-17</td>
<td>Guinea pig</td>
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<td>EN-18</td>
<td>Monkey, t. s.</td>
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REVIEW BOX SLIDE 98
Adrenal Gland

The adrenal gland has a distinct cortex and medulla, each of different embryologic origin and different function.

The cells of the cortex and the medulla have the familiar cord and sinus arrangement, which facilitates contact between the cells that make hormones and the blood flowing past them. The cells of the adrenal cortex all synthesize steroid hormones, and have a "foamy" appearance in some sections. This is due to the extensive lipid material in them, and to the numerous SER and Golgi profiles in their cytoplasm.

The Adrenal Cortex

The adrenal gland as a whole is surrounded by a distinct CT capsule, which sends a few septa into the parenchyma of this gland; generally, though, there is little internal lobulation. The layers of cells immediately beneath the capsule are organized into the zona glomerulosa, or "region of little globes".

Deep to this layer is a second distinct region where the cells form somewhat more regular rows, radiating away from the center of the gland. This is the zona fasciculata, the name coming from the Latin word "fasciae" a bundle of sticks. Like sticks bound together, these cords of cells run in roughly the same direction.

The cells in that region of the cortex closest to the medulla lose this regular arrangement, and are organized into anastomosing cords to form a network-like zona reticularis. Separating the rows and cords of cells are irregular vascular channels, or sinusoids similar to those in the liver.

The Adrenal Medulla

The adrenal medulla comes from an entirely different embryonic rudiment than does the cortex. The corticomедullary junction is quite easy to see. The cells of the adrenal medulla are somewhat more basophilic than those of the cortex.

List of slides – Adrenal gland

EN-19 Mammal
EN-20 Mammal
EN-21 Human
EN-22 Human, t. s.
EN-23 Monkey, t. s.
EN-24 Bat
EN-25 Cat
EN-26 Cat
EN-27 Opossum
EN-28 Rat
EN-29 Rabbit

REVIEW BOX SLIDE 98

Thyroid and Parathyroid Glands

Thyroid gland

The organization of the gland into follicles is easily seen. The follicles are hollows balls of cells, each with a wall composed of simple cuboidal epithelium. The amorphous material present inside the follicles is colloid, an inactive storage form of the gland's secretion. The thyroid is unique among endocrine glands in that it stores its secretory product extracellularly. Indeed, it's unusual for an endocrine gland to store products at all.

In the regions between the follicles, CT cells of the septa which divide the organ are present. Also present are the C-cells or clear cells, sometimes called parafollicular cells. These are oval shaped larger, and more lightly stained than the follicular cells are. They are often hard to identify in H & E preparations,
but you should be able to find a few. The C-cells do not produce colloid; they produce the hormone calcitonin instead.

**Parathyroid gland**

The parathyroid gland is formed by four small oval bodies associated with the thyroid gland, but which are separate endocrine organs in and of themselves. You will note that this structure has its own distinct capsule, and is not lobulated as is the thyroid gland.

Like other endocrine organs it's well vascularized, and all of the functional cells of the parathyroid parenchyma are closely associated with a blood vessel. The most numerous parathyroid cells are the chief cells, with a round nucleus and weakly stained cytoplasm. Other types have been described but are much rarer and will not be considered here. The chief cells produce parathyroid hormone (or parathormone, as it's sometimes called, abbreviated PTH)

**List of slides – Thyroid**

 EN-5  Mammal  
 EN-6  Human, t. s.  
 EN-7  Monkey, t. s.  

**List of slides – Parathyroid**

 EN-8  Human  
 EN-9  Human  
 EN-10  Human, t. s.  
 EN-11  Monkey, t. s.  
 EN-12  Thyroiditis  
 EN-13  Parathyroid and thyroid  
 EN-14  Parathyroid and thyroid  
 En-15  Parathyroid and thyroid  

REVIEW BOX SLIDES 95, 96