HISTOLOGY AND PHYSIOLOGY OF ADRENAL GLAND IN MAMMALS

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These are pair of endocrine glands, one associated with each kidney.

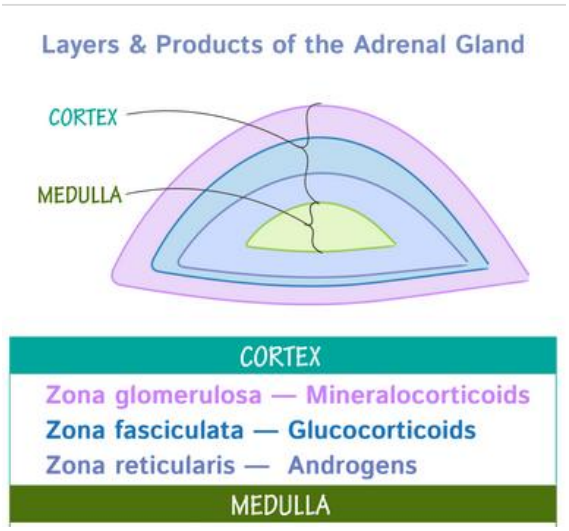
They have an inner medulla and outer cortex, and there are different types of endocrine tissue in each.

The embryological origin of the cortex, is similar to that of the gonads. The embryological origin of the medulla is the same as that of the sympathetic nervous system.

Adrenal cortex

All the hormones secreted by this region are steroid hormones, which are all based on cholesterol. Secretory cells, secrete steroid based hormones, and contain triglyceride droplets. The cortex can be divided into three regions:

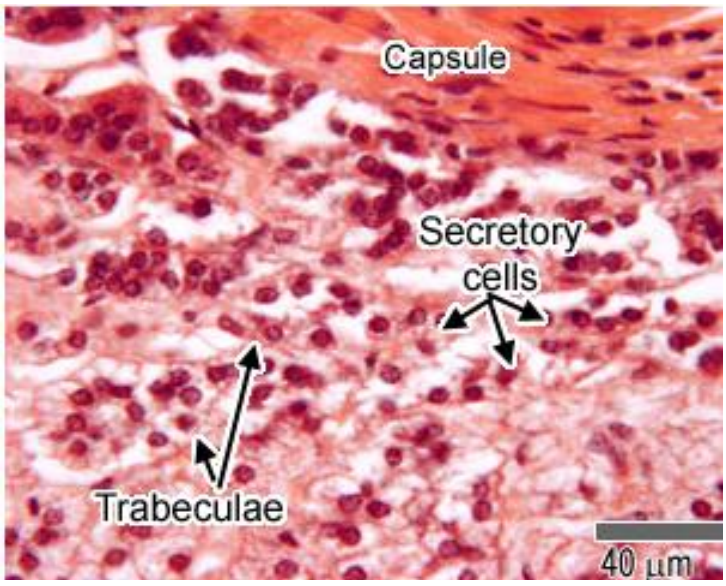
- **Zona glomerulosa**
- **Zona fasciculata**
- **Zona reticularis**



Different hormones are secreted from each of these regions

1. Zona glomerulosa, The outermost zone of the adrenal cortex secretes mineralcorticoids. These hormones are important for fluid homeostasis. These include aldosterone, which regulates absorption/uptake of K+ and Na+ levels in the kidney.

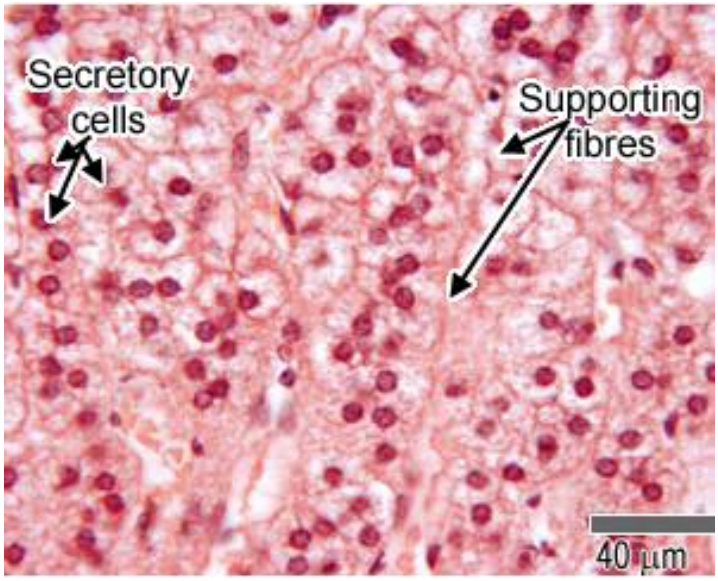
The nuclei stain strongly, and the cytoplasm is less pale than that of the next zone, the zona fasciculata, as there are fewer lipid droplets in these cells.



2. Zona fasciculata, The middle zone of the adrenal cortex secretes glucocorticoids which are important for carbohydrate, protein and lipid metabolism. An example is cortisol which raises blood glucose and cellular synthesis of glycogen. Its secretion is controlled by a hormone from the pituitary - ACTH.

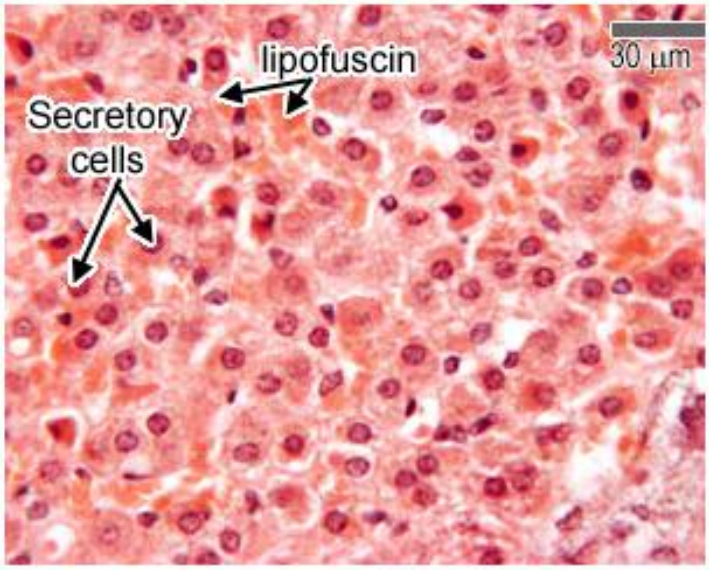
The secretory cells are arranged in cords, often one cell thick, surrounded by fine strands of supporting tissue. Can you identify them?

The nuclei of these cells stain strongly, and the cytoplasm is rich in sER, mitochondria and lipid droplets. The cytoplasm looks pale and 'foamy' due to the presence of lipid droplets.



3. Zona reticularis, The innermost layer of the cortex, secretes sex hormones (androgens). and small amounts of glucocorticoids. These hormones are secreted by the inner zone of the cortex, which is called the zona reticularis.

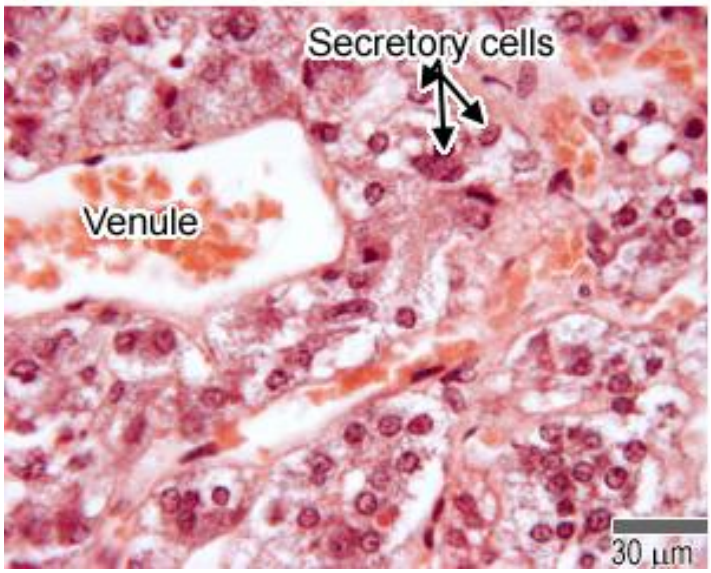
Some brown pigment is seen in some of these cells - this is lipofuscin, probably an insoluble degradation product of organelle turnover - an 'age' pigment. The cytoplasm of the cells in this region stains more darkly, and contains fewer lipid droplets.



Adrenal medulla:

This region of the adrenal glands contains basophilic staining cells, with a granular cytoplasm and no stored lipid. It also contains many venous channels which drain blood from the sinusoids of the cortex, pass through the medulla, and drain into the medullary vein.

This is because these cells are actively secreting the peptide based hormones - nor-adrenaline and adrenalin (catecholamines), which are stored in the granules.



Cortex

- Accounts for the other 80% of the adrenal gland.
- It is of mesodermal origin.
- Secretes:
  Mineralocorticoids.
  Glucocorticoids.
  Androgens.

Cortical Hormones

- Hormonal secretion is triggered by ACTH stimulation (from anterior lobe of pituitary)
- Secretes steroid hormones; cholesterol is common precusor.

- Enzyme availability accounts for differential hormonal production in the cortical layers.

Zona reticularis

- Primarily produces androgens
  Includes DHEA and androstenendione, which are precursor hormones that can be converted to testosterone and estradiol; thus, they are a non-gonadal source of "sex-steroids."

Zona fasciculata

- Primarily produces glucocorticoids, including cortisol, which has multiple effects throughout the body: increases gluconeogenesis and glycogen storage, suppresses the inflammatory response, and maintains vascular response to catecholamines. Thus, it is secreted in response to mental or physical stressors.

Zona glomerulosa

- Produces mineralocorticoids
- Specifically, angiotensin II (which we discuss in renal physiology), drives the production of aldosterone, which increases sodium reabsorption and potassium secretion in the late distal tubules and collecting ducts of the nephron;
  Thus, it is secreted in response to decreased extracellular fluid volume to conserve body water.