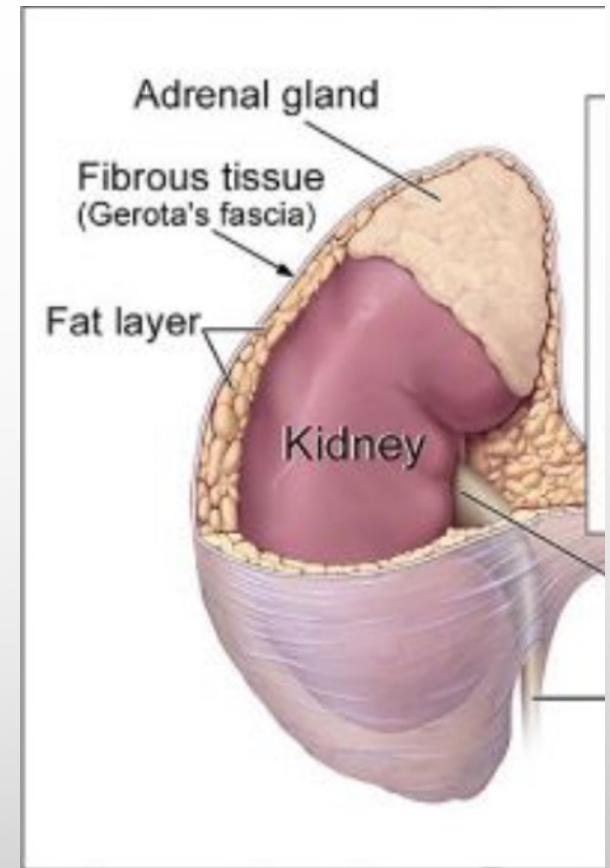


The background of the slide is a light gray gradient. It is decorated with several realistic-looking water droplets and bubbles of various sizes, scattered across the top and bottom edges. The droplets have highlights and shadows, giving them a three-dimensional appearance.

ADRENAL GLAND

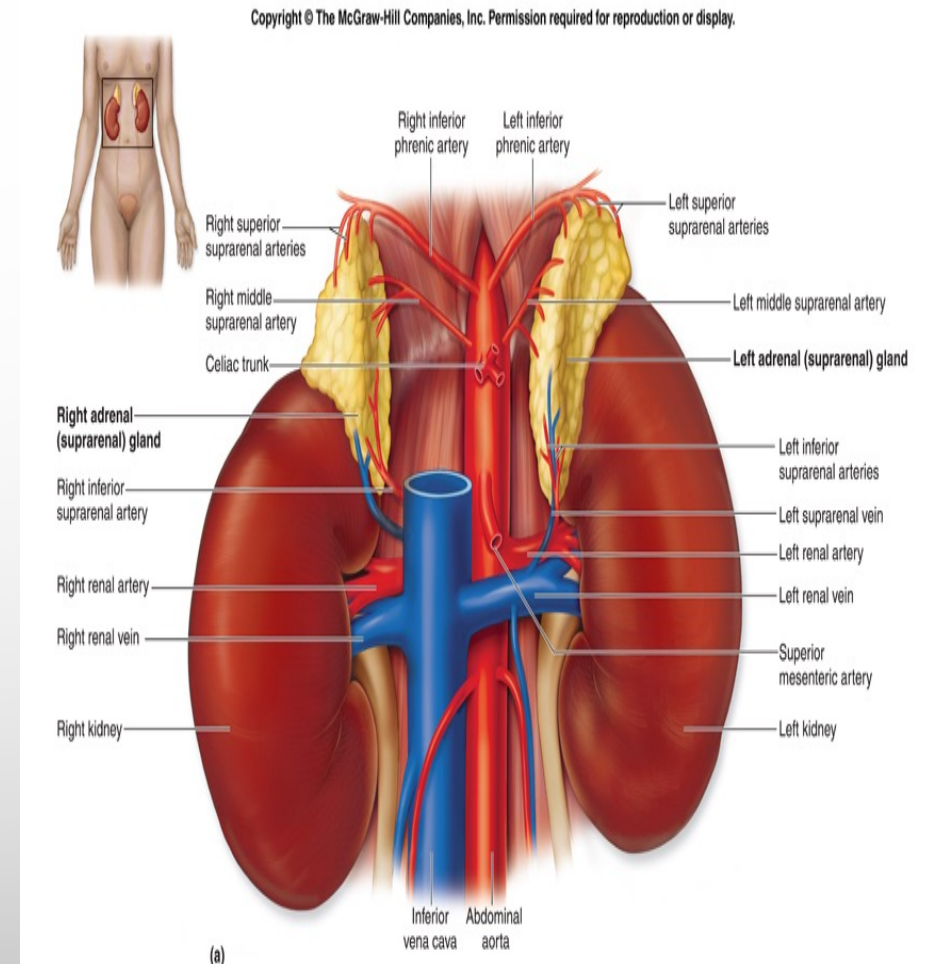
ADRENAL GLAND

- Yellowish retroperitoneal organs that lie on the upper poles of the kidneys
- Surrounded by **renal fascia**
- Separated from the kidneys by the perirenal fat.
- Has a yellow cortex and a dark brown medulla.
- Lacks a hilum; suprarenal arteries arising from larger abdominal arteries penetrate the capsule independently
- Lie close to critical vessels and organs



LOCATION AND DESCRIPTION

- The **right** is pyramid shaped:
- Caps the upper pole of the right kidney.
- It lies behind the right lobe of the liver and extends medially behind the inferior vena cava.
- It rests posteriorly on the diaphragm.
- The **left** is crescentic in shape:
- Extends along the medial border of the left kidney from the upper pole to the hilus.
- It lies behind the pancreas, the lesser sac, and the stomach
- Rests posteriorly on the diaphragm.



Blood supply

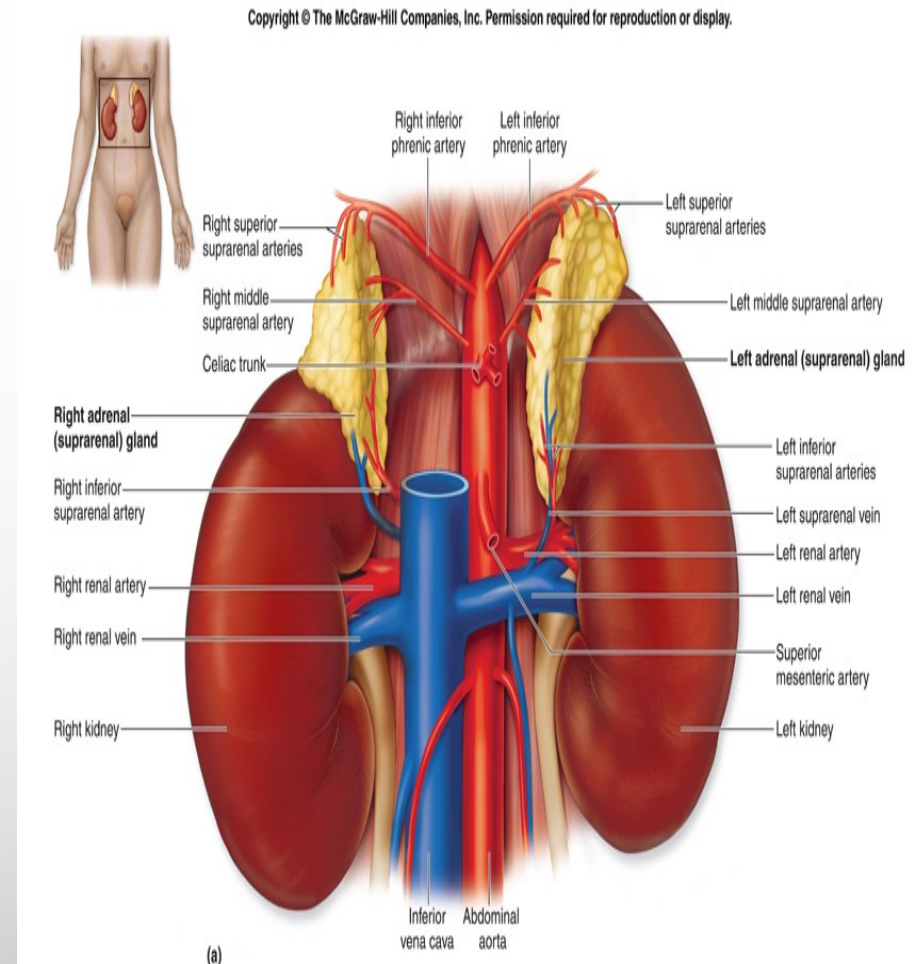
- A superior, middle, and inferior suprarenal arteries branches from inferior phrenic, aorta, and renal artery, respectively.
- A single **vein** emerges and drains into the IVC on the right and into the renal vein on the left.

Lymph drainage

- Drains into the lateral aortic nodes.

Nerve supply

- Preganglionic sympathetic fibers derived from the splanchnic nerves (bilateral visceral autonomic nerves) supply the glands (T5–T8 spinal cord segments)
- Most of the nerves end in the medulla of the gland.





STRUCTURE

A cortex and a medulla

The cortex secretes:

- **Mineral corticoids**; control of fluid and electrolyte balance.
- **Glucocorticoids**; control of the metabolism of carbohydrates, fats, and proteins.
- **Sex hormones** (small amounts); probably play a role in the prepubertal development of the sex organs.

The medulla secretes:

- **Catecholamines** epinephrine and norepinephrine.
- 

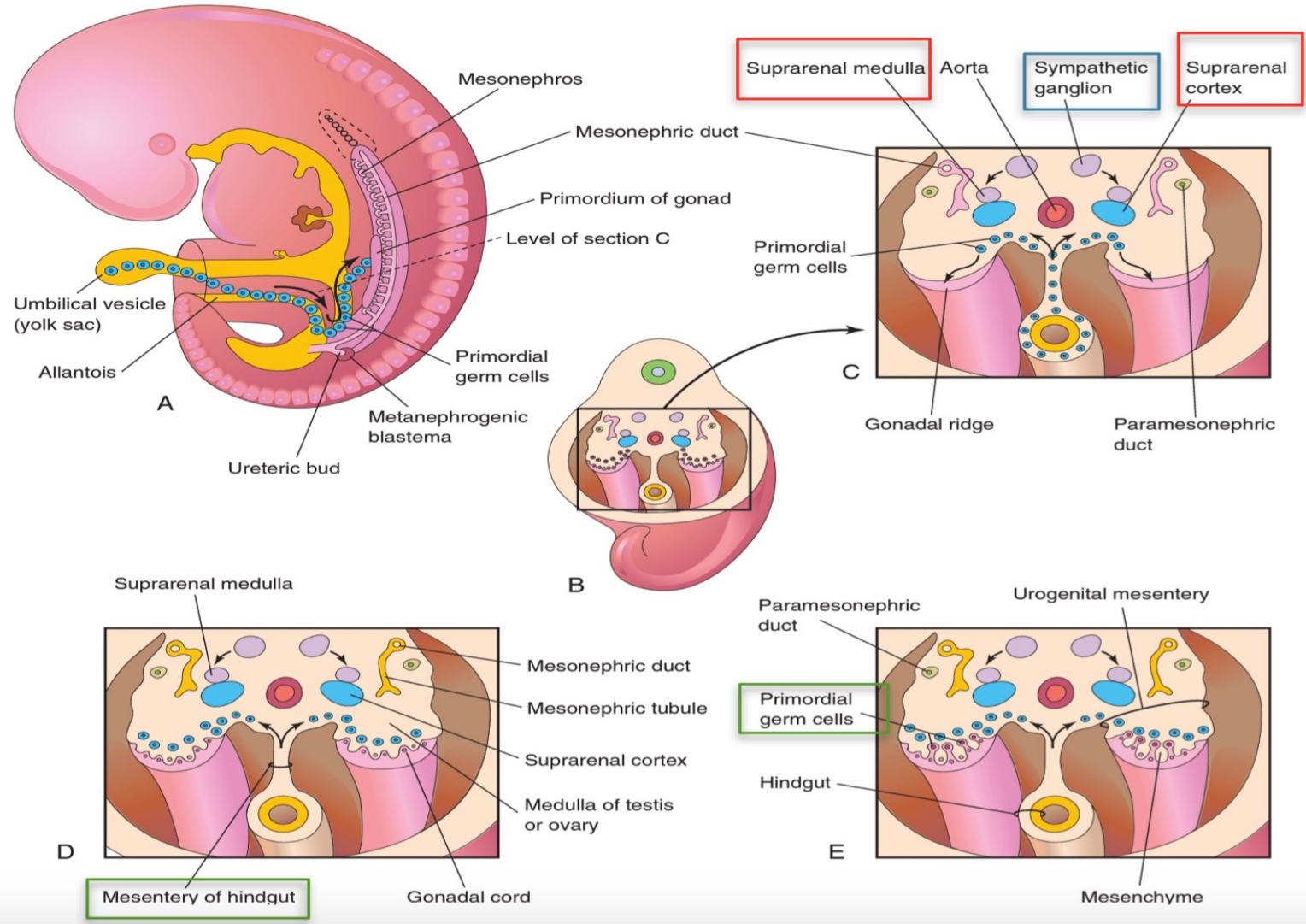
ORGANOGENESIS--CORTEX

- Develops from two components: a mesodermal portion---cortex, and an ectodermal portion---- medulla.
- During the 5th week (4-6 week), mesothelial cells between the root of the mesentery and the developing gonad (within the urogenital ridge--- the adrenal-gonadal primordial germ cells) begin to proliferate and penetrate the underlying mesenchyme.
- Here they differentiate into large acidophilic organs, which form the **fetal cortex, or primitive cortex**.
- Shortly afterward, a second wave of cells (smaller) from the mesothelium penetrates the mesenchyme and surrounds the original acidophilic cell mass--- **definitive cortex** of the gland.
- **After birth**, the fetal cortex regresses rapidly (largely completed in the first few weeks of life) except for its outermost layer, which differentiates into the **reticular zone**.
- The adult structure of the cortex is not achieved **until puberty**.

ORGANOGENESIS--MEDULLA

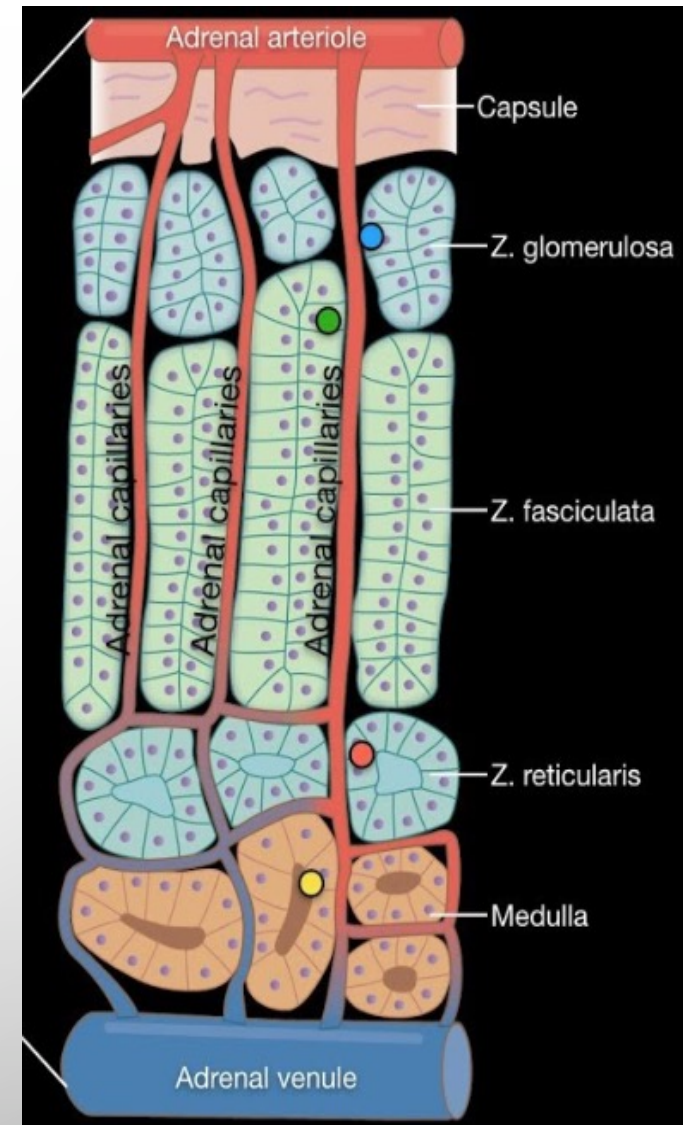
- While the fetal cortex is being formed, cells originating in the sympathetic system (sympathochromaffin cells—neural crest) invade its medial aspect, where they are arranged in cords and clusters.
- These cells give rise to the medulla of the suprarenal gland.
- They stain yellow-brown with chrome salts and hence are called chromaffin
- The medulla comes to occupy a central position.
- During embryonic life, chromaffin cells are scattered widely throughout the embryo, but in the adult the only persisting group is in the medulla of the adrenal glands.
- Preganglionic sympathetic nerve fibers grow into the medulla and influence the activity of the medullary cells.

ORGANOGENESIS



HISTOLOGY

- Cells of cortex and medulla are grouped in cords along wide capillaries.
- Suprarenal arteries -----subcapsular arterial plexus.
- From this plexus arterioles for the adrenal cortex and medulla emerge separately----- networks of fenestrated capillaries and sinusoids.
- Cortical capillaries irrigate endocrine cells then drain into the medulla.
- The medulla----- **dual** blood supply:
- Venous drainage from the glands occurs via the suprarenal veins

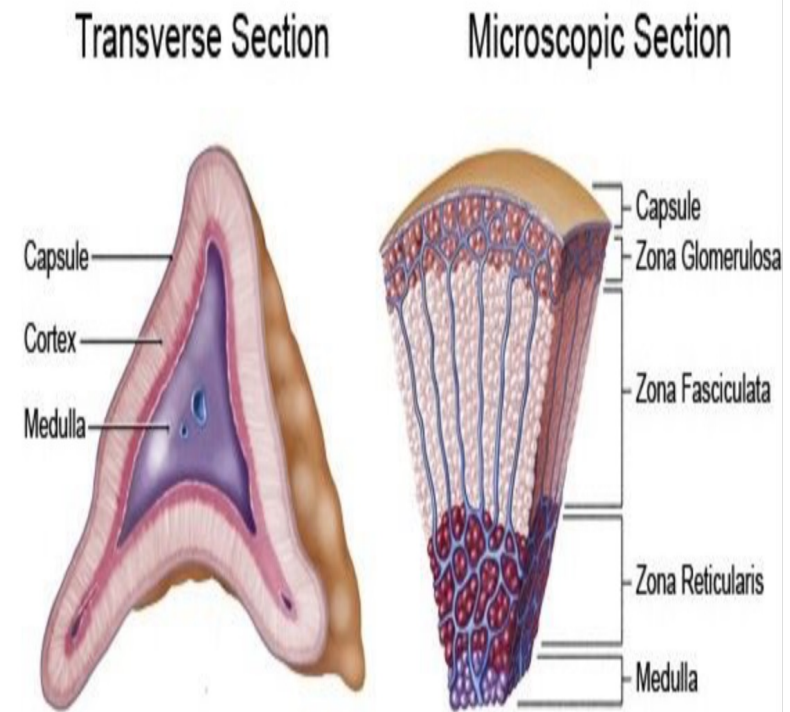


ADRENAL CORTEX

- Steroid-secreting cells: acidophilic cytoplasm rich in lipid droplets, with central nuclei.
- Profuse SER of interconnected tubules, which contain the enzymes for cholesterol synthesis and conversion of the steroid prohormone pregnenolone into specific active steroid hormones.
- The mitochondria are often spherical, with tubular rather than shelflike cristae.
- The function of steroid-producing cells involves close collaboration between SER and mitochondria.

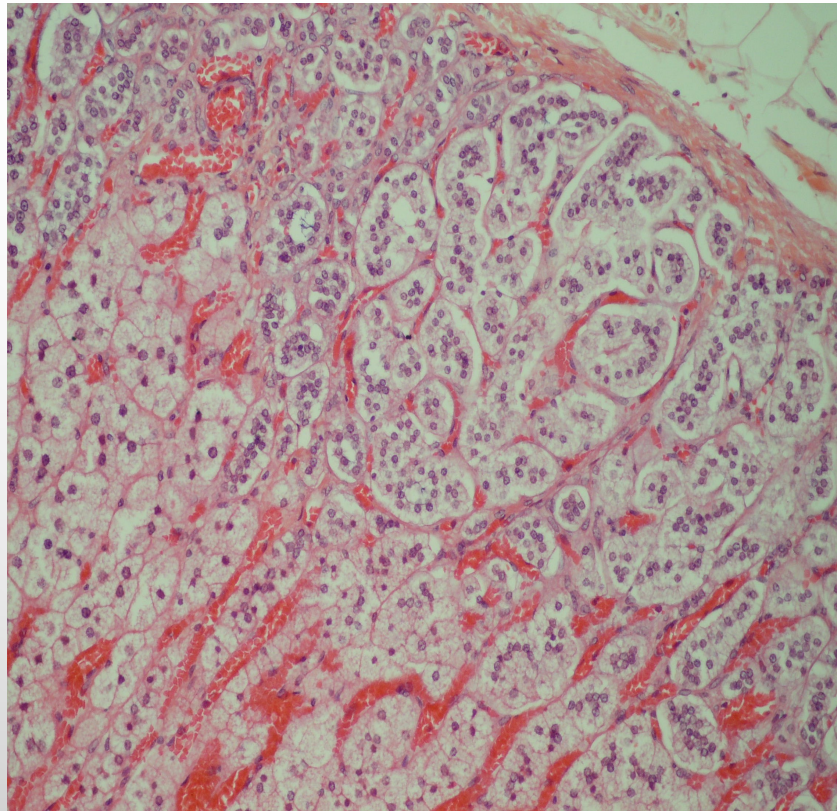
ADRENAL CORTEX

- Steroid hormones are not stored in granules ---- small lipid-soluble molecules, steroids diffuse freely from cells
- The adrenal cortex has three concentric zones.
 1. **Zona glomerulosa**
 2. **Zona fasciculata**
 3. **Zona reticularis**



CORTEX- ZONA GLOMERULOSA

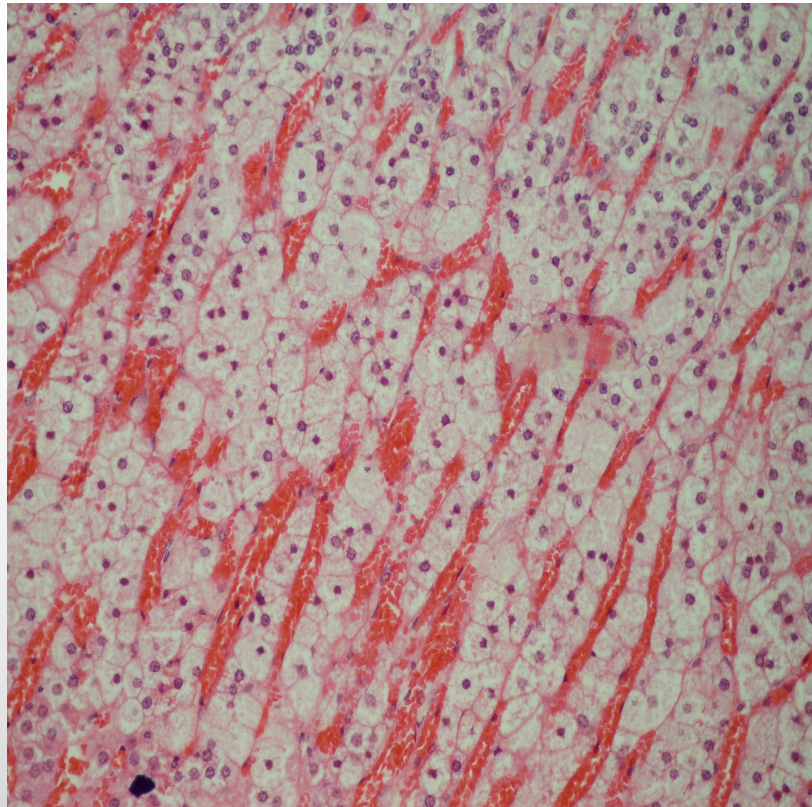
- Immediately inside the capsule and comprising about 15% of the cortex
- Consists of closely packed, rounded or arched cords of columnar or pyramidal cells.
- Many capillaries



- The steroids made by these cells are called **mineralocorticoids**
- The principal product is **aldosterone** (uptake of Na^+ , K^+ and water by cells of renal tubules).

CORTEX- ZONA FASCICULATA

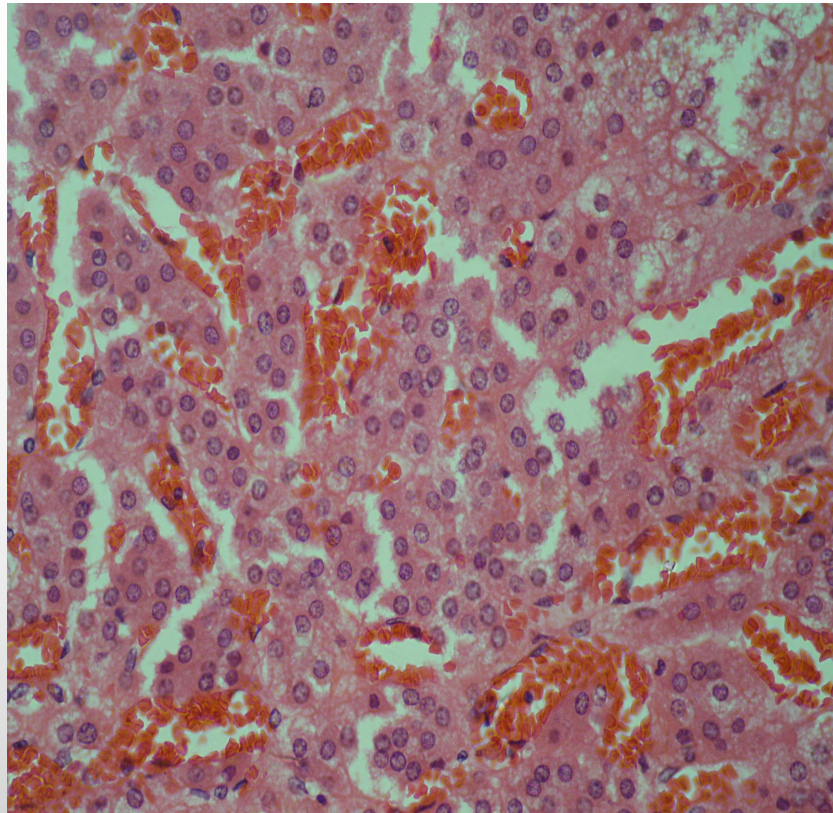
- 65%-80% of the cortex
- Long cords of large polyhedral cells, one or two cells thick,
- Fenestrated sinusoidal capillaries
- The cells are filled with lipid droplets.
- Secrete **glucocorticoids**, especially cortisol (carbs metabolism--- gluconeogenesis in many cells (liver))



- Suppresses many immune functions.
- Induce fat mobilization and muscle proteolysis.
- Secretion is controlled by ACTH (negative feedback)
- Small amounts of weak androgens are also produced here.

CORTEX- ZONA RETICULARIS

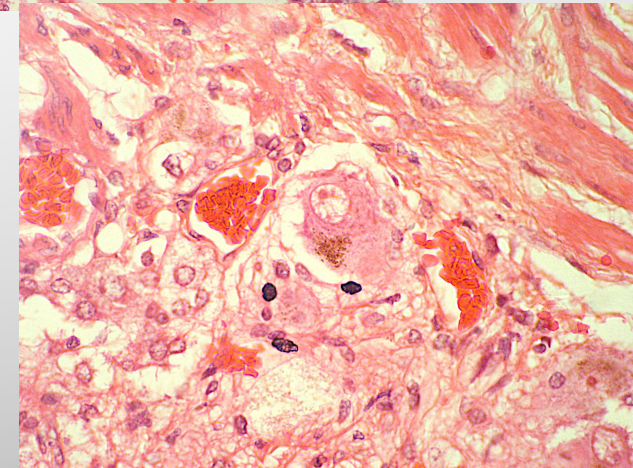
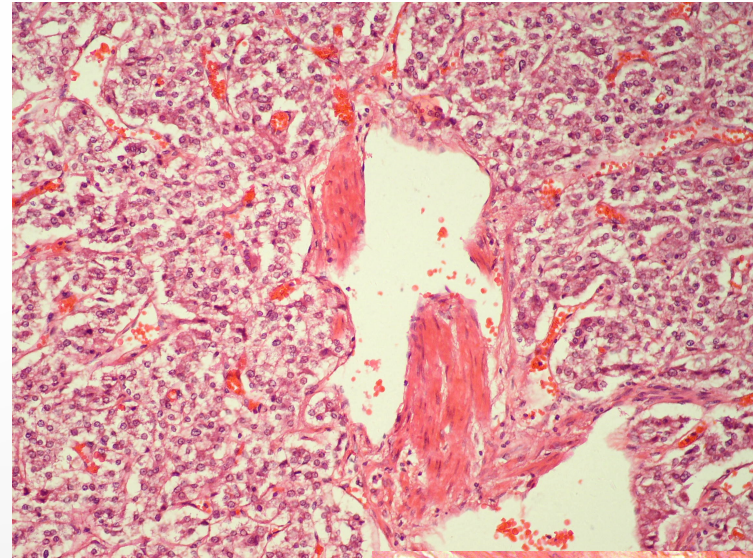
- 10% of the cortex.
- Consists of smaller cells in a network of irregular cords interspersed with
- Wide capillaries
- The cells are more heavily stained than those of the other zones (fewer lipid droplet and more lipofuscin pigment)



- Primarily secrete the weak androgens (also produce cortisol).
- Dehydroepiandrosterone (DHEA) that is converted to testosterone in both men and women.
- Secretion is stimulated by ACTH with regulatory feedback.

THE ADRENAL MEDULLA

- Composed of large, pale-staining polyhedral cells--- cords or clumps and supported by a reticular fiber network
- A profuse supply of sinusoidal capillaries intervenes between adjacent cords
- A few parasympathetic ganglion..
- Medullary parenchymal cells, known as **CCs** (modified sympathetic postganglionic neurons; lacking axons and dendrites).



THE ADRENAL MEDULLA (AM)

- CCs contain many electron-dense granules (catecholamines, either epinephrine or norepinephrine)
- The conversion of norepinephrine to epinephrine (adrenalin) occurs only in chromaffin cells of the AM.
- About 80% of the catecholamine secreted from the adrenal is epinephrine.
- Medullary CCs are innervated by **preganglionic** sympathetic neurons.
- **Epinephrine** increases heart rate, dilates bronchioles, and dilates arteries of cardiac and skeletal muscle.
- **Norepinephrine** constricts vessels of the GIT and skin, increasing blood flow to the heart, muscles, and brain.
- **Both** hormones stimulate glycogen breakdown, elevating blood glucose levels.
- During **normal** activity, the adrenal medulla continuously secretes **small** quantities of these hormones.

SURGICAL SIGNIFICANCE/ TRAUMA

Surgical significance of renal fascia

- The suprarenal glands, together with the kidneys, are enclosed within the renal fascia.
- The suprarenal glands lie in a separate compartment, which allows the two organs to be separated easily at operation.

Susceptibility to trauma at birth

- The suprarenal glands are relatively large at birth because of the presence of the fetal cortex.
- Later, when this part of the cortex involutes, the gland becomes reduced in size.
- During the process of involution, the cortex is friable and susceptible to damage and severe hemorrhage.

ANS/AG

