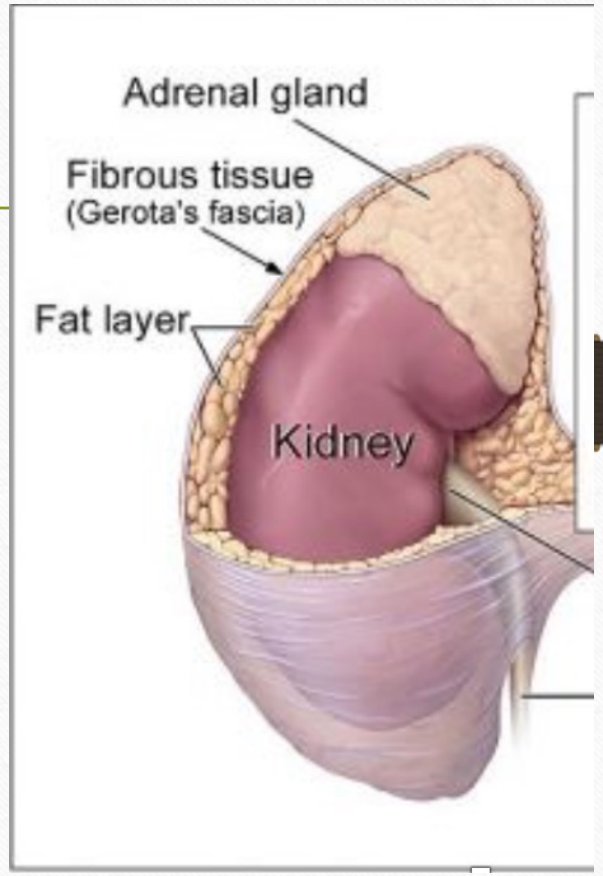
Adrenal Gland

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



The cortex secretes:

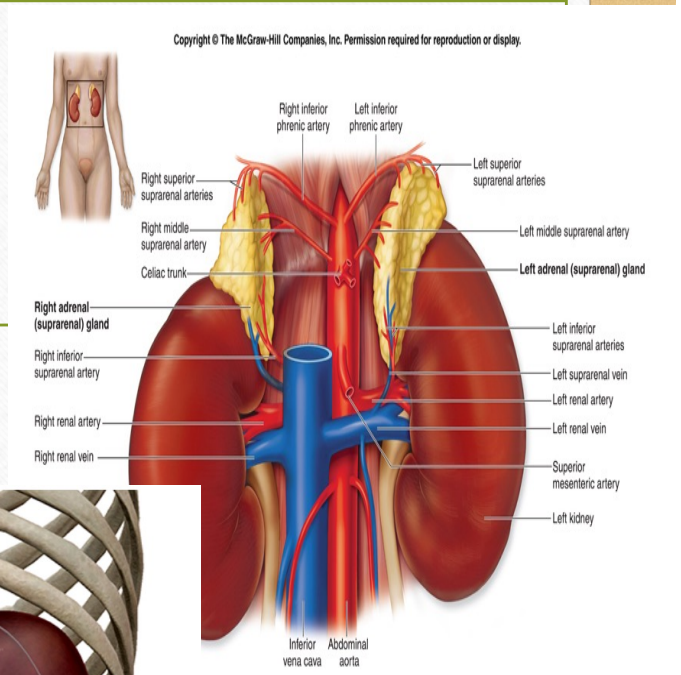
- **Mineral corticoids:** control of fluid and electrolyte balance.
- **Glucocorticoids:** control of the metabolism of carbohydrates, fats, and proteins.
- **Sex hormones** (small amounts): probably play a role in the prepubertal development of the sex organs.

The medulla secretes:

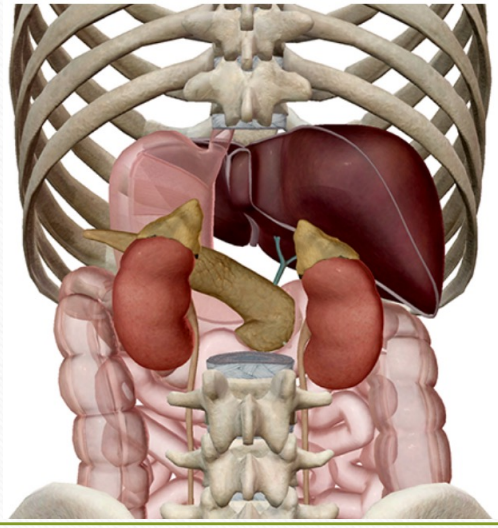
- **Catecholamines** epinephrine and norepinephrine.

Location and Description

- The **right** is pyramidal in shape.
- Caps the upper pole of the right kidney.
- It lies behind the right lobe of the liver and extends medially behind the IVC.
- 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 hilum.
- It lies behind the pancreas, the lesser sac, and the stomach
- Rests posteriorly on the diaphragm.



Blood supply

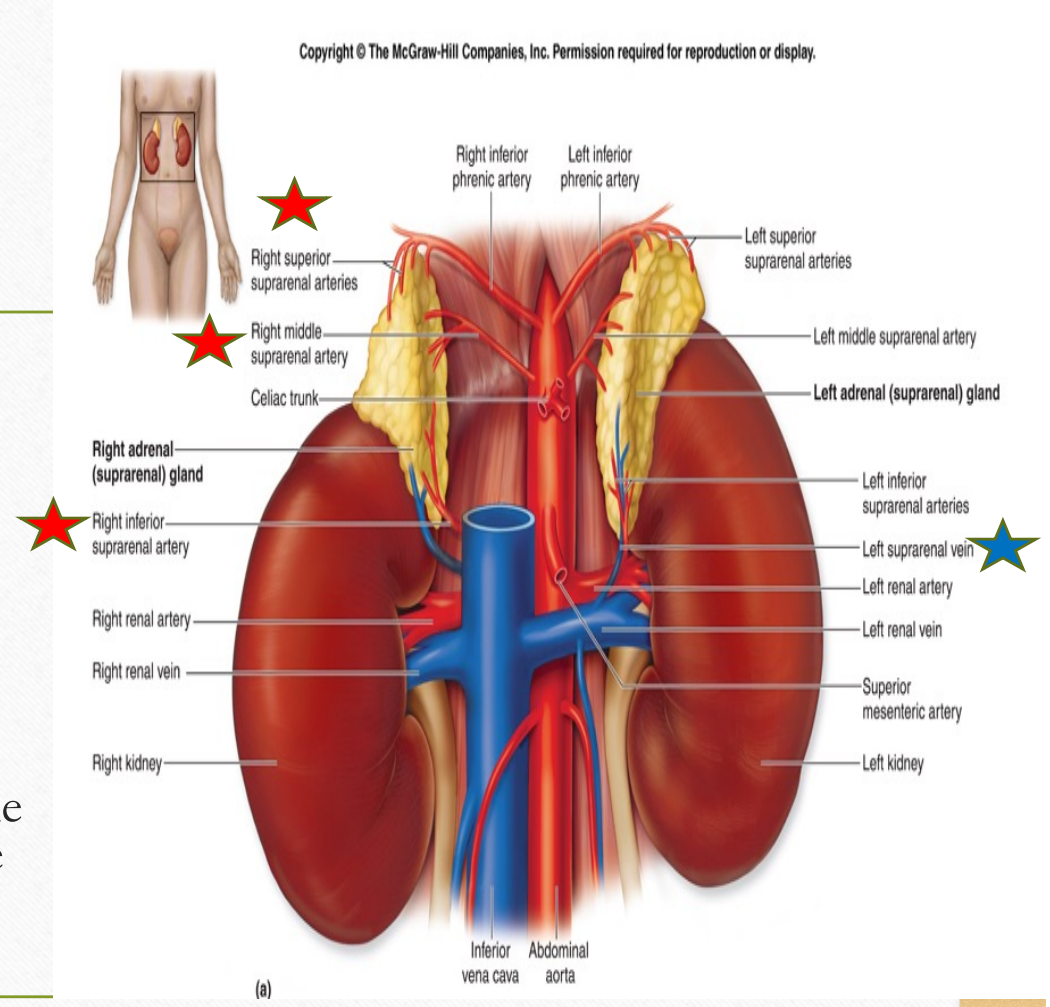
- A superior suprarenal artery (inferior phrenic artery).
- A middle suprarenal artery (aorta).
- An inferior suprarenal artery (renal artery).
- A single **vein** emerges from the hilum (base) of each gland and drains into the IVC on the right and into the renal vein on the left.

Lymph drainage

- The lymph drains into the lateral aortic nodes.

Nerve supply

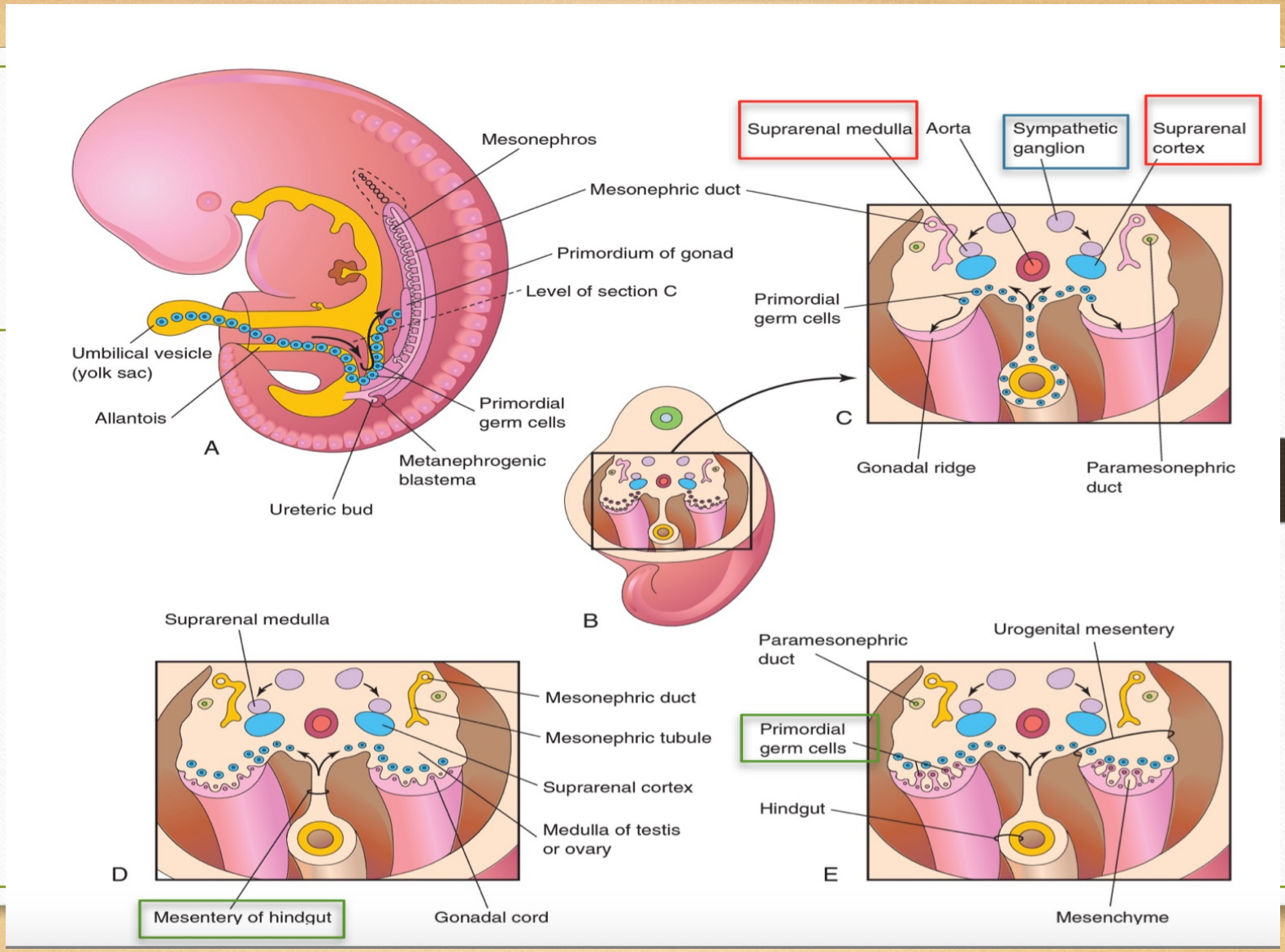
- Preganglionic sympathetic fibers derived from the splanchnic nerves supply the glands. Most of the nerves end in the medulla of the gland.



Organogenesis--cortex

- Develops from two components: a mesodermal portion---cortex, and an ectodermal portion----medulla.
- During the 5th week, mesodermal cells between the root of the mesentery and the developing gonad begin to proliferate and penetrate the underlying mesenchyme (adrenal-gonadal primordial germ cells).
- 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



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—7th week.
- These cells give rise to the medulla.
- They stain yellow-brown with chrome salts and hence are called chromaffin.
- The medulla comes to occupy a central position and is arranged in cords and clusters.
- Preganglionic sympathetic nerve fibers grow into the medulla and influence the activity of the medullary cells.

Organogenesis

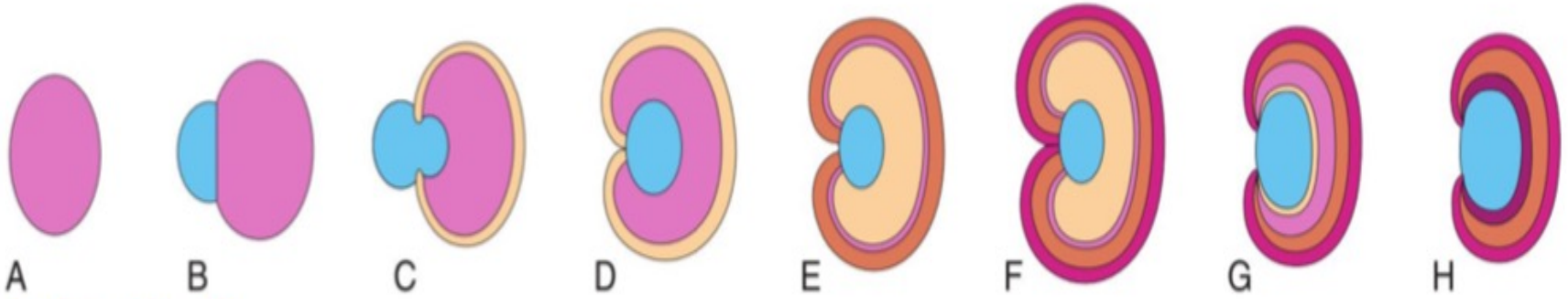
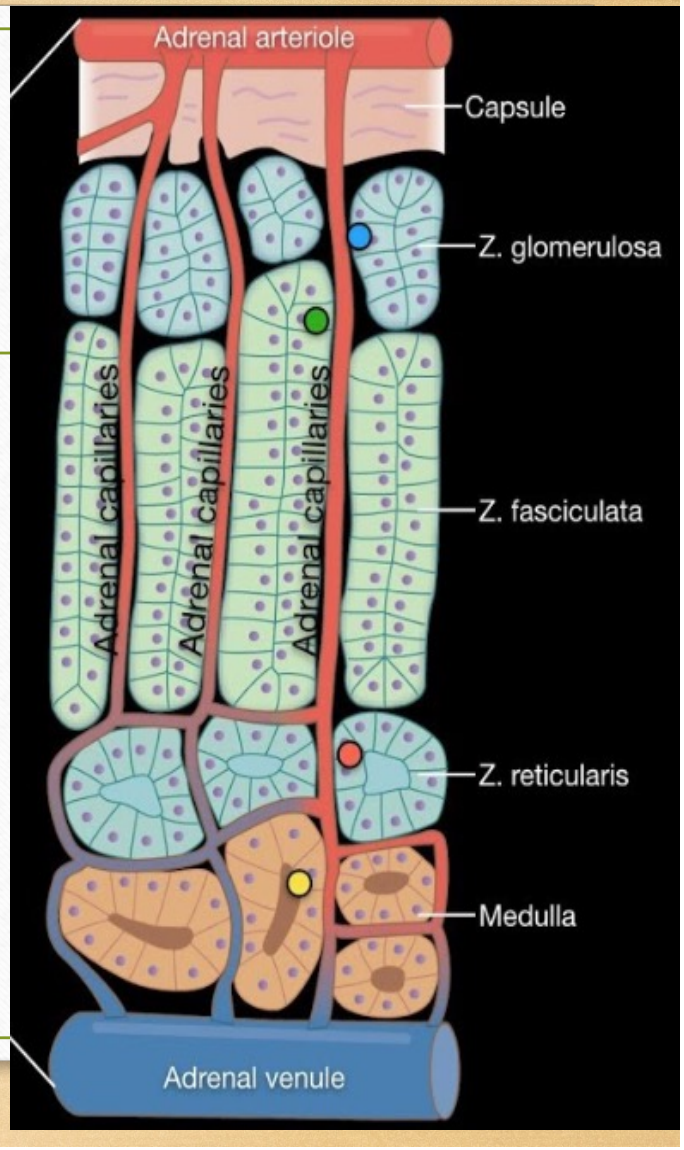


FIGURE 12–27 Schematic drawings illustrating development of the suprarenal glands. **A,** At 6 weeks, showing the mesodermal primordium of the fetal cortex. **B,** At 7 weeks, showing the addition of neural crest cells. **C,** At 8 weeks, showing the fetal cortex and early permanent cortex beginning to encapsulate the medulla. **D** and **E,** Later stages of encapsulation of the medulla by the cortex. **F,** Gland of a neonate showing the fetal cortex and two zones of the permanent cortex. **G,** At 1 year, the fetal cortex has almost disappeared. **H,** At 4 years, showing the adult pattern of cortical zones. Note that the fetal cortex has disappeared and that the gland is much smaller than it was at birth (*F*).

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



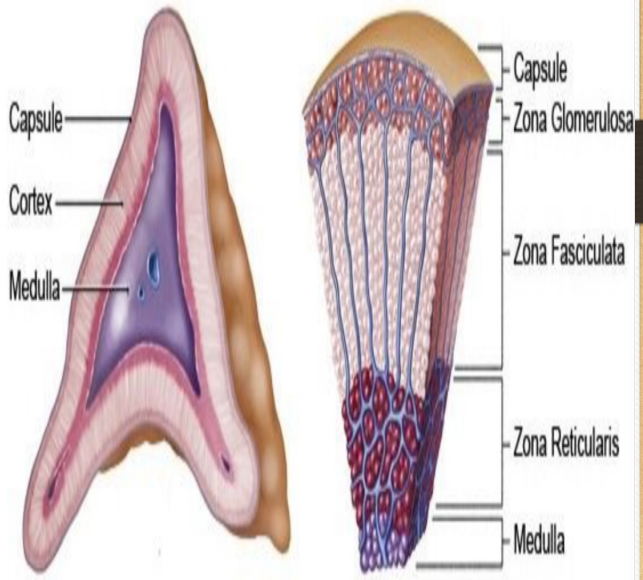
Adrenal Cortex

- 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 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

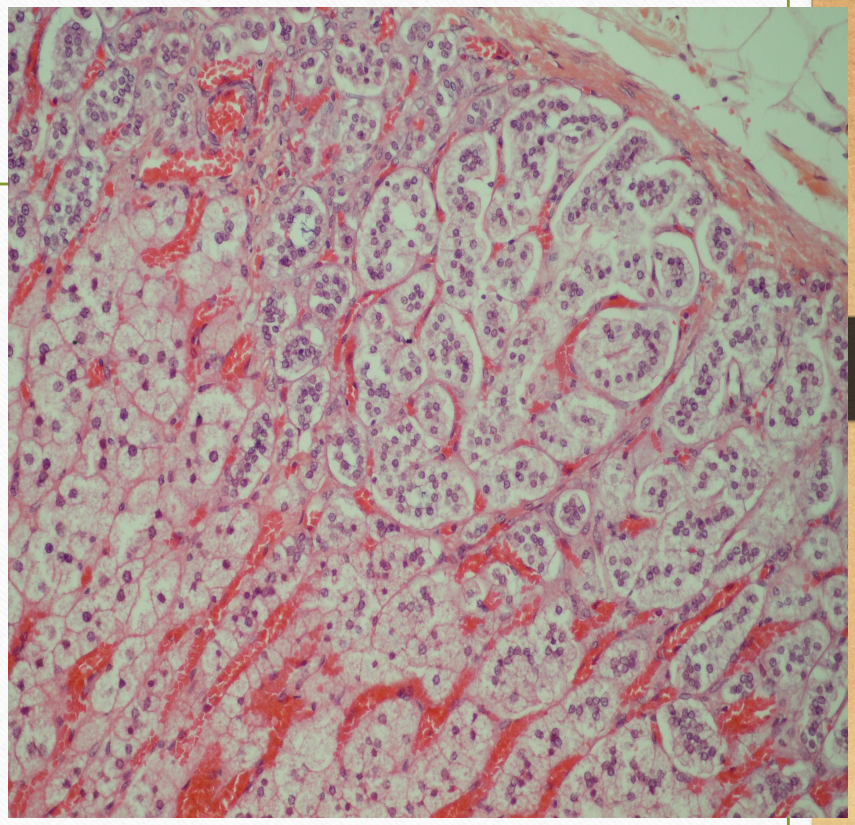
- Steroid hormones are not stored in granules ---- small lipid-soluble molecules, steroids diffuse freely from cells
- The adrenal cortex has three concentric zones.

1. **Zona glomerulosa**
2. **Zona fasciculata**
3. **Zona reticularis**



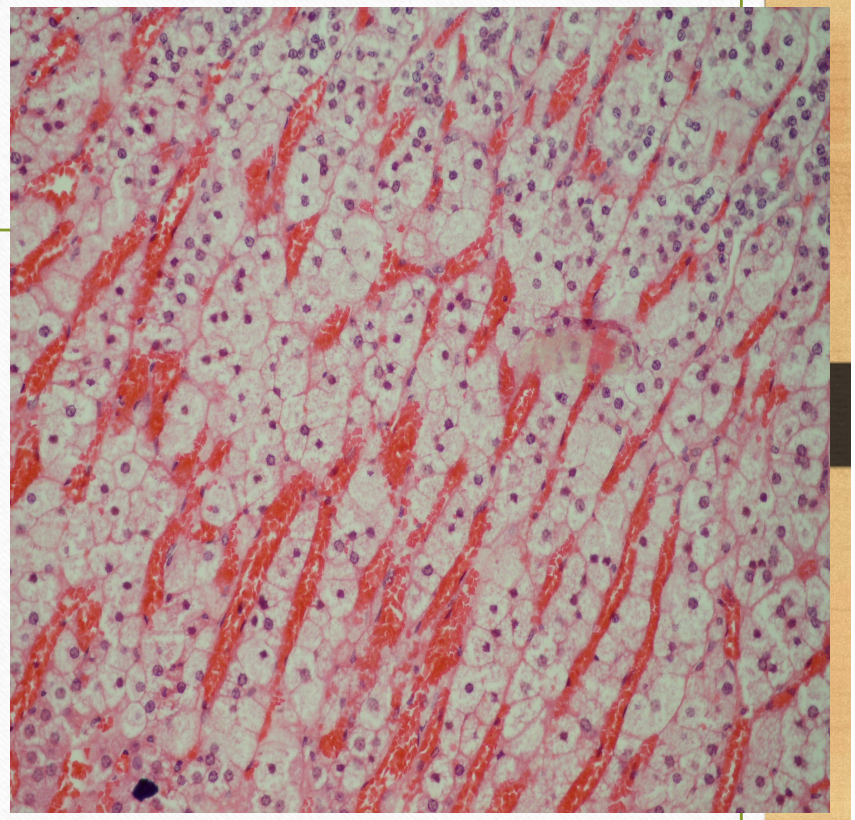
Cortex- zona glomerulosa

- 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 are called mineralocorticoids
- The principal product is aldosterone (uptake of Na+, K+, and water by cells of renal tubules).
- Aldosterone secretion is stimulated primarily by angiotensin II (increase in plasma K+ concentration, weakly by ACTH.



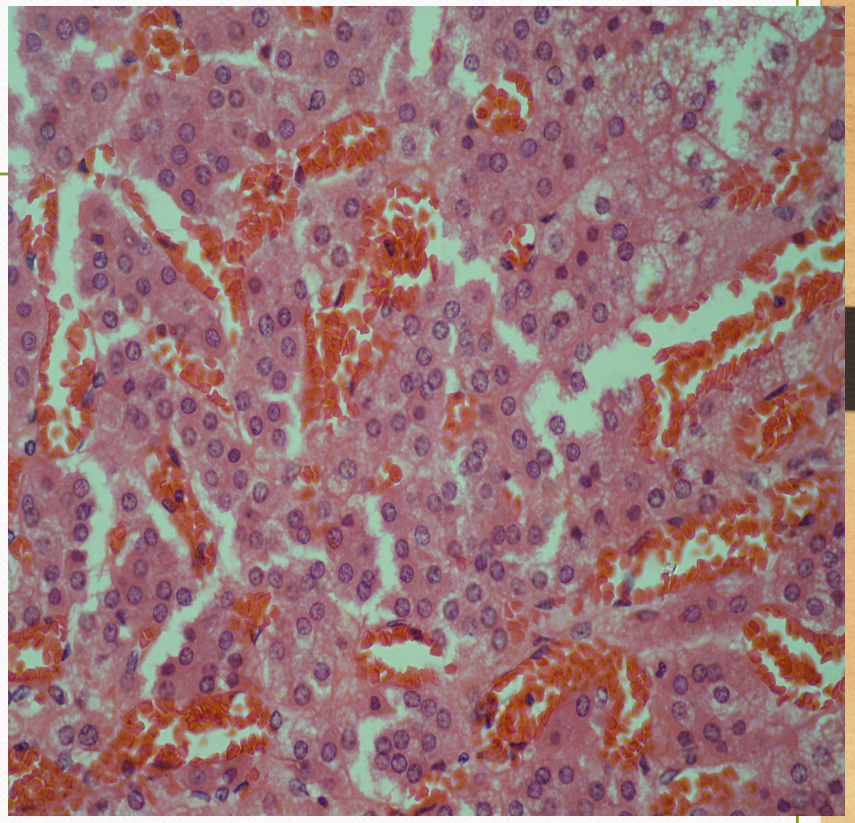
Cortex- zona fasciculata

- 65%-80% of the cortex
- Long cords of large polyhedral cells, one or two cells thick,
- Fenestrated sinusoidal capillaries
- 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.



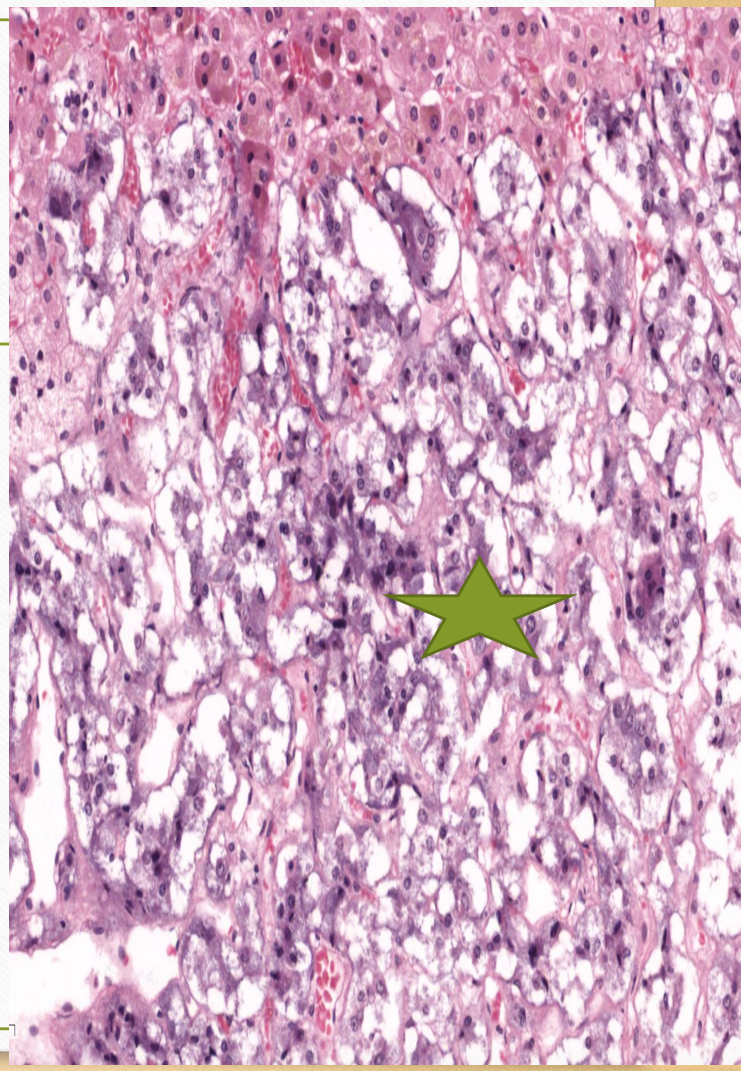
Cortex- zona reticularis

- 10% of the cortex and
- 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 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.
- 80% of the catecholamine secreted from the adrenal is epinephrine.
- Medullary CCs are innervated by **preganglionic** sympathetic neurons.

The adrenal medulla (AM)

- **Epinephrine** increases heart rate, dilates bronchioles, and dilates arteries of cardiac and skeletal muscle.
- **Norepinephrine** constricts vessels of the digestive system 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.