

Suprarenal (adrenal) Glands



Two small yellowish glands situated anterosuperior to each superior renal pole.

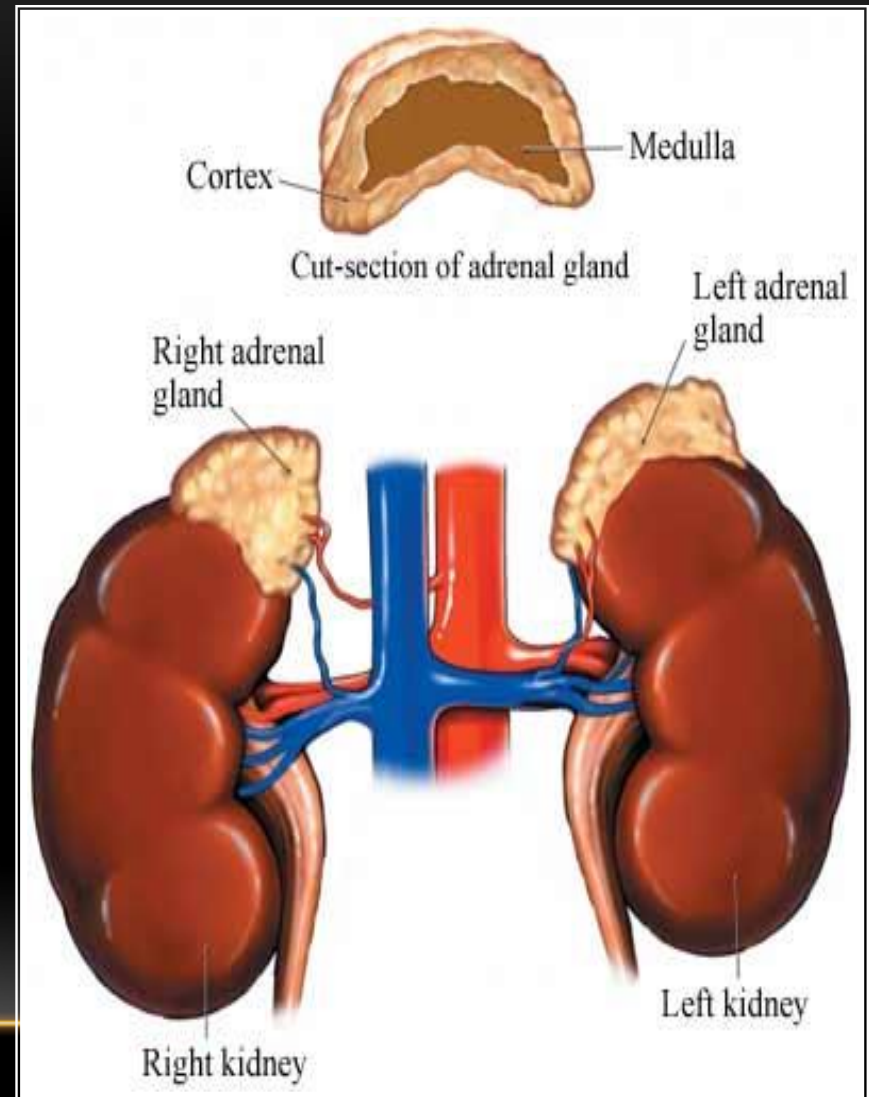
Retroperitoneal and located at the level of T12.

Surrounded connective tissue that contains perinephric fat.

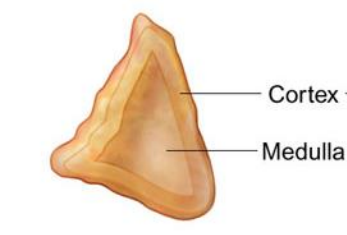
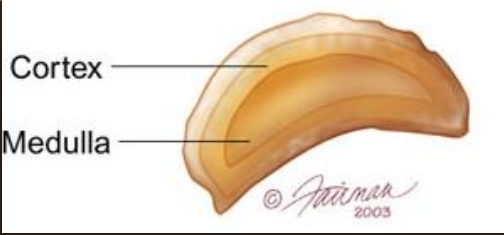
Enclosed by renal fascia but separated from the kidneys by fibrous tissue.

Each divided into: Cortex and Medulla.

Each gland is: ~50X30X10mm. Its weight is ~ 5gm (90% cortex and 10% medulla).



Comparison between Rt. & Lt. Suprarenals

| Right Suprarenal | Left Suprarenal |
|---|---|
|  |  |
| Triangular (pyramidal) | Crescentic (semilunar) |
| Does NOT reach the hilum of the right kidney | Reaches the hilum of the left kidney |
| The hilum is directed upwards | The hilum is directed downwards |
| Its vein is short and drains to the IVC | Its vein is long and drains to the left renal vein. |

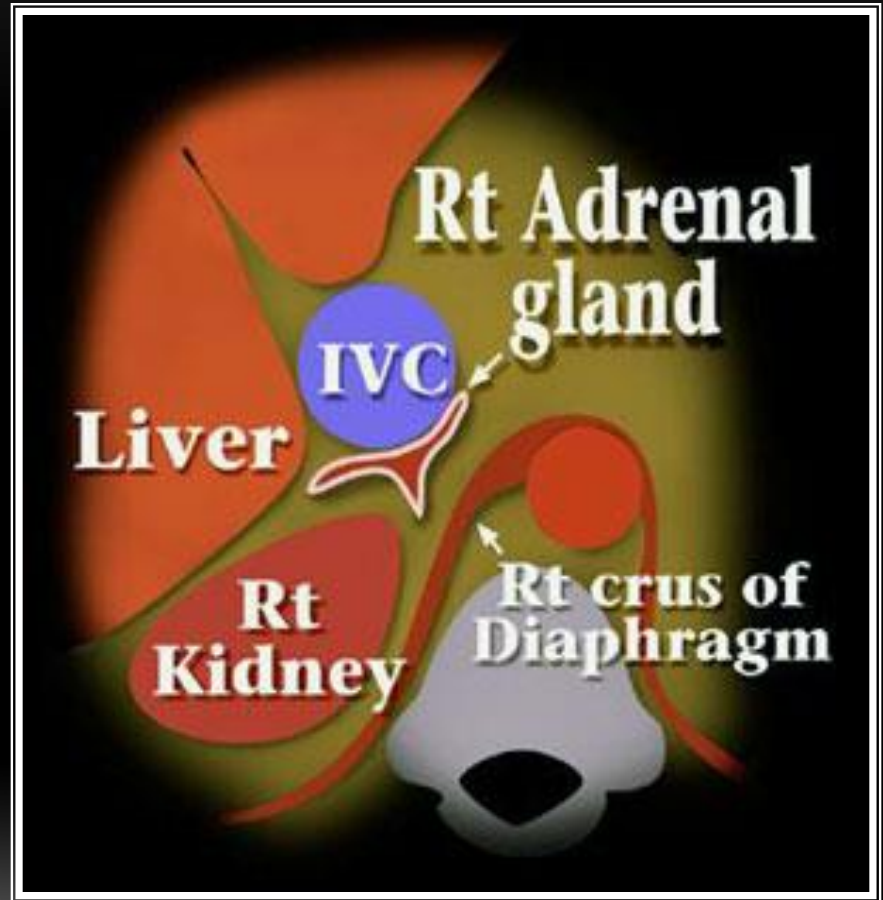
Relations of the right suprarenal gland

Anteriorly:

- Inferior vena cava (medially)
- Right hepatic lobe (laterally)

Posteriorly:

- Diaphragm (right crus)
- Superior pole of the right kidney



Relations of the left suprarenal gland

Anteriorly:

- Stomach
- Lesser sac of peritoneum
- The inferior area is in touch with the pancreas and splenic vein.

Posteriorly:

- Diaphragm (left crus)
- Superior pole of the left kidney

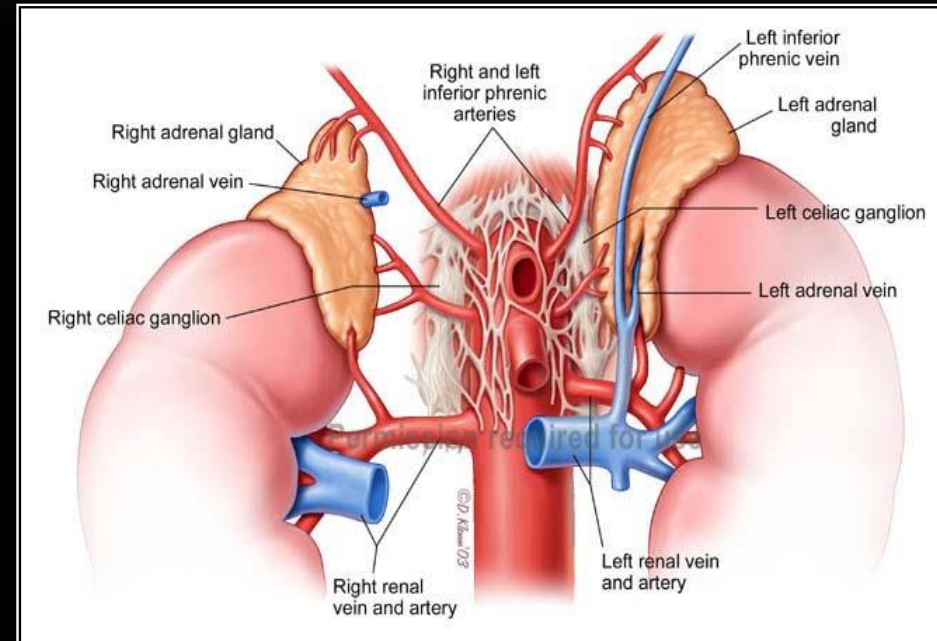


Blood supply of the adrenals.. 1

Each gland receives 3 arteries:

- Superior suprarenal a. from the inferior phrenic artery
- Middle suprarenal a. from the abdominal aorta.
- Inferior suprarenal a. from the renal artery.

The suprarenal gland receives the highest blood supply in the body/gm of tissue.

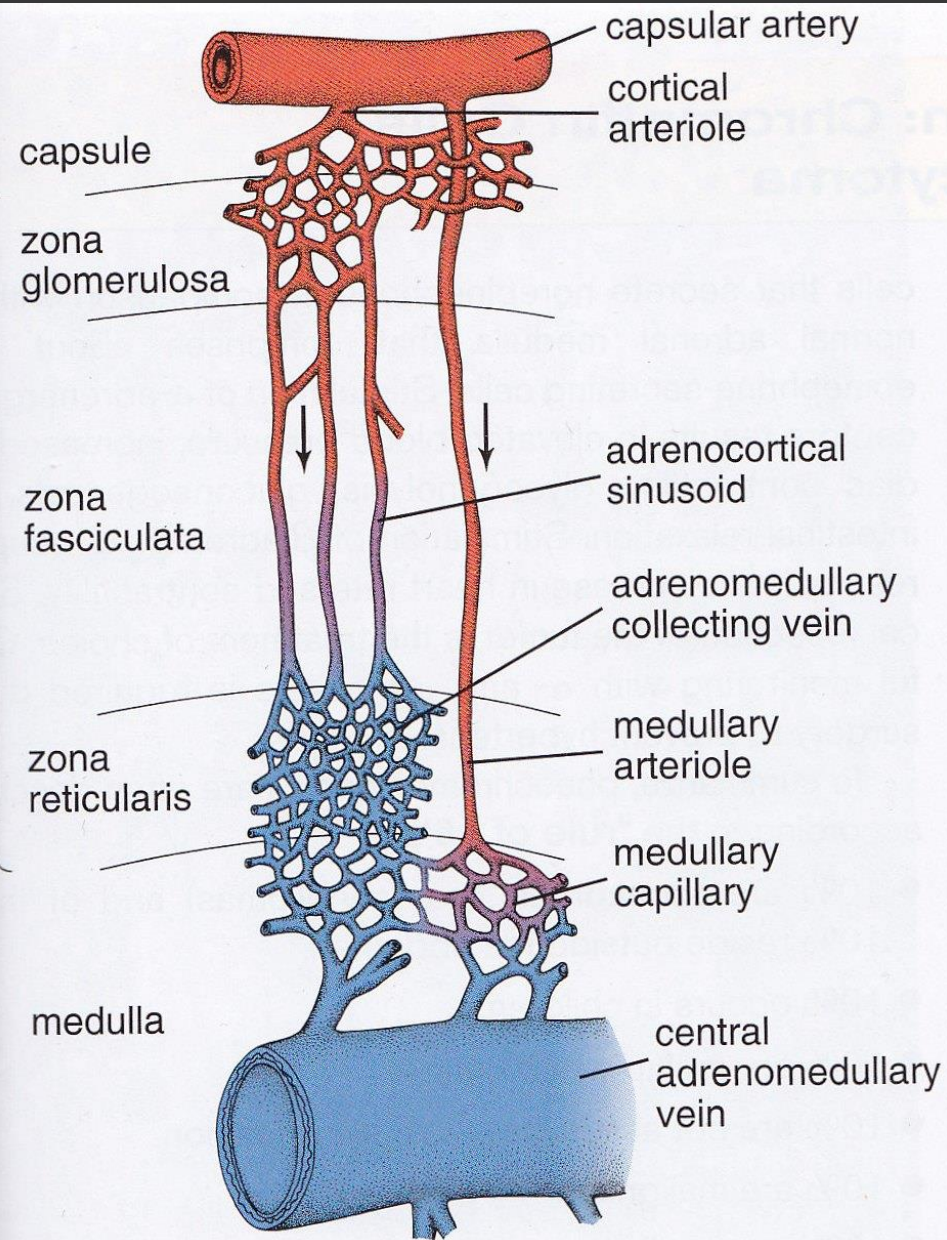


Blood supply of the adrenals.. 2

Arteries branch before entering the capsule.

The capsule is penetrated by ~ 60 arterioles.

- In the capsule the arteries re-branch forming a system that consists of:
 - Capsular arteries.
 - Fenestrated cortical sinusoidal capillaries draining into fenestrated medullary capillaries.
 - Medullary arterioles: bring arterial blood to medullary capillaries

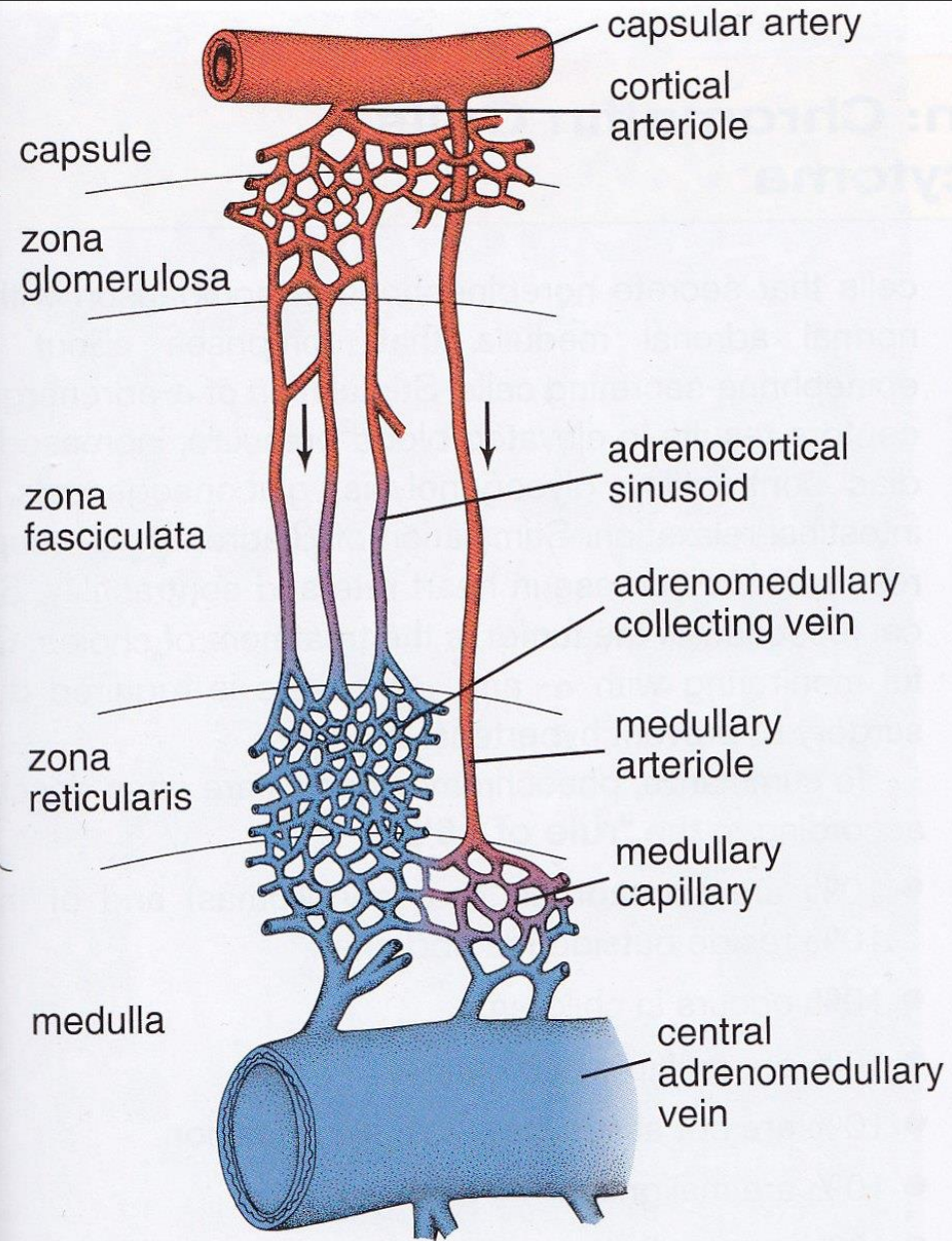


Blood supply of the adrenals .. 3

Medulla has dual blood supply:

- Medullary arterioles, and
- Cortical capillaries.

Veunules arising from cortical and medullary sinusoids drain into small adrenomedullary collecting veins → central adrenomedullary vein → IVC or left renal vein.



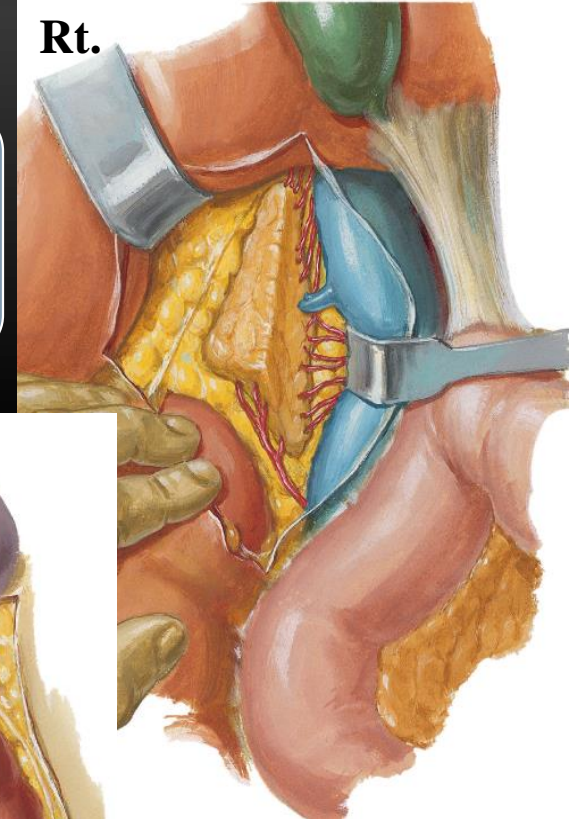
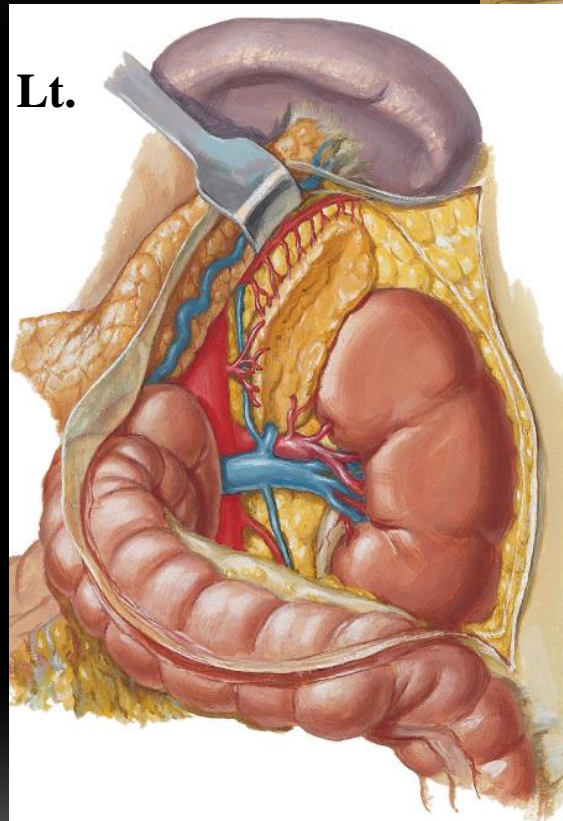
Blood supply of the adrenals ..4

Venous drainage of the adrenal glands is achieved via the suprarenal veins:

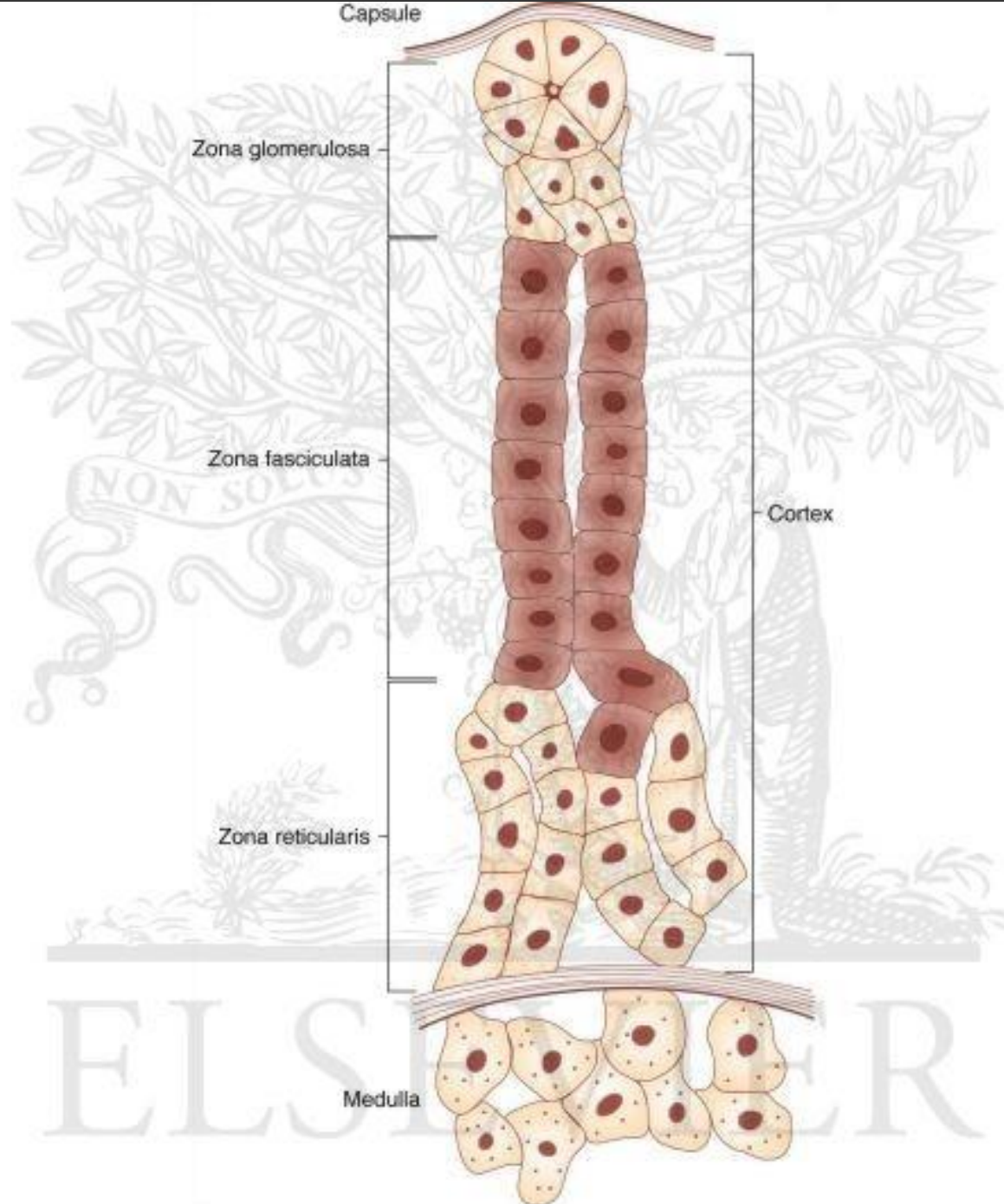
- The right suprarenal vein (short) drains into the inferior vena cava
- The left suprarenal vein (longer) drains into the left renal vein or the left inferior phrenic vein.

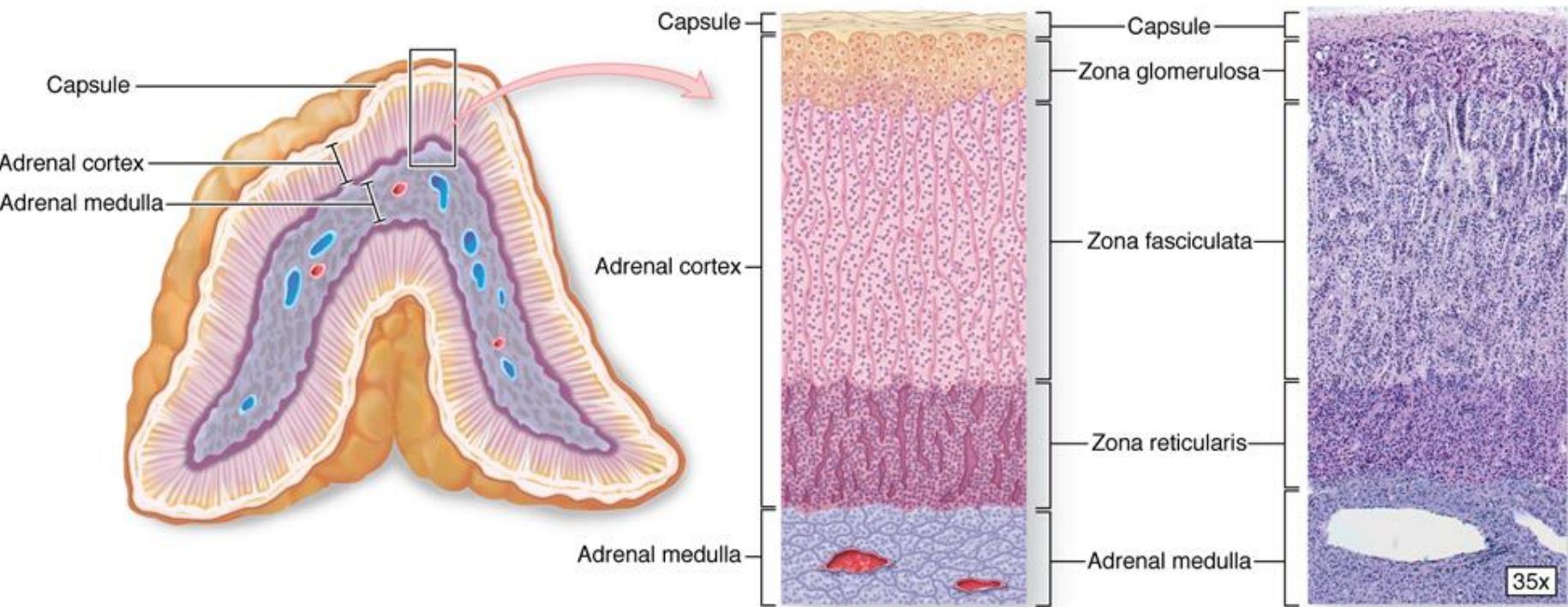
The suprarenal veins may form anastomoses with the inferior phrenic veins.

The right vein emerges from the medial aspect is directed upwards



The left vein emerges from the anterior surface and is directed downwards





Embryology

Cortex is mesodermal in origin

Week 4 – 6 : start from coelomic mesoderm adjacent to urogenital ridge.

Week 8: differentiate into thin definite outer cortex and thick inner fetal cortex.

Fetal cortex produce steroid during gestation and involutes at birth.

Definite cortex develop into functional adrenal cortex.

Medulla derived from neural crest cells

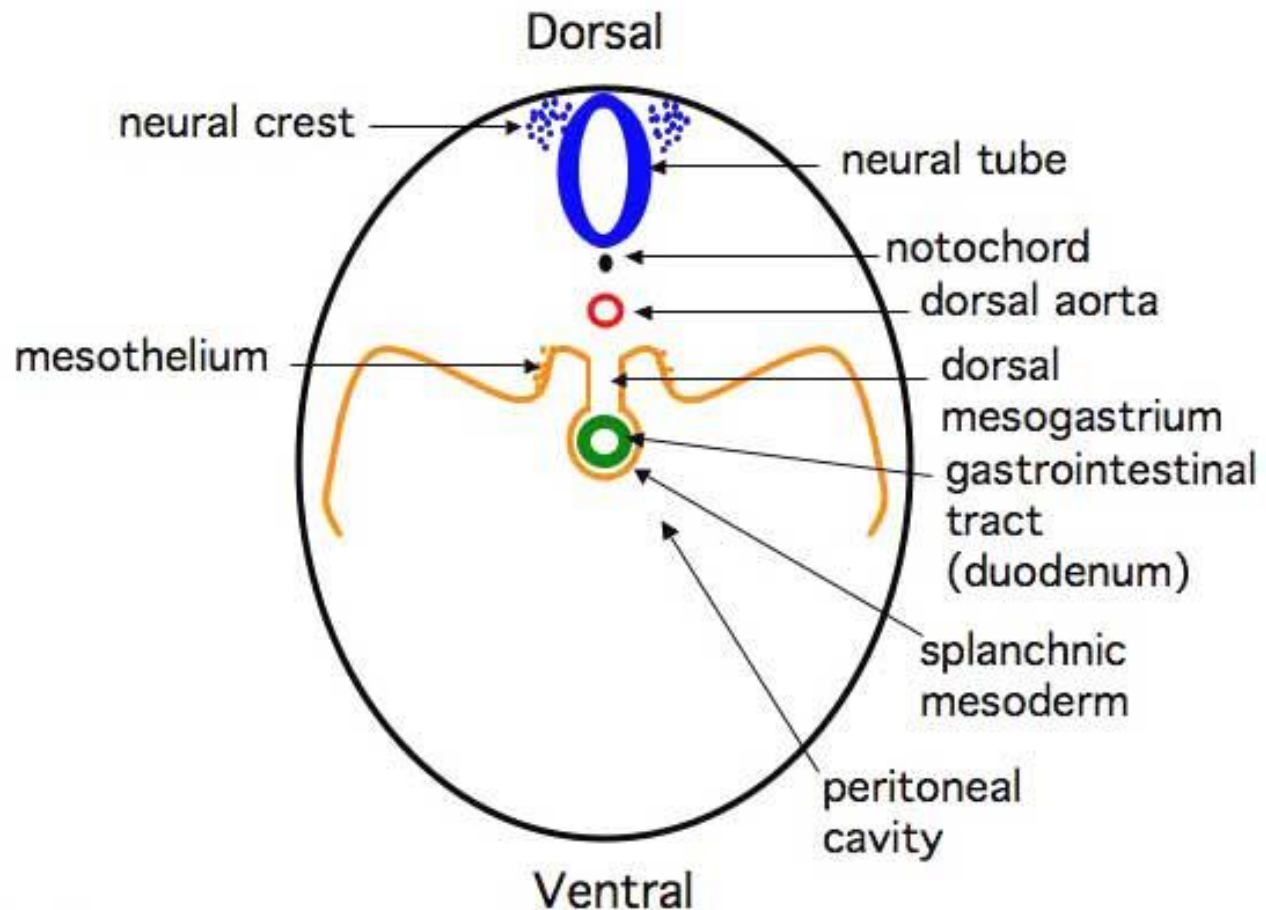
- Develop with sympathetic nervous system

Week 5 : neural crest cell migrate to Para-aortic and Para-vertebral region towards medial aspect of adrenal cortex.

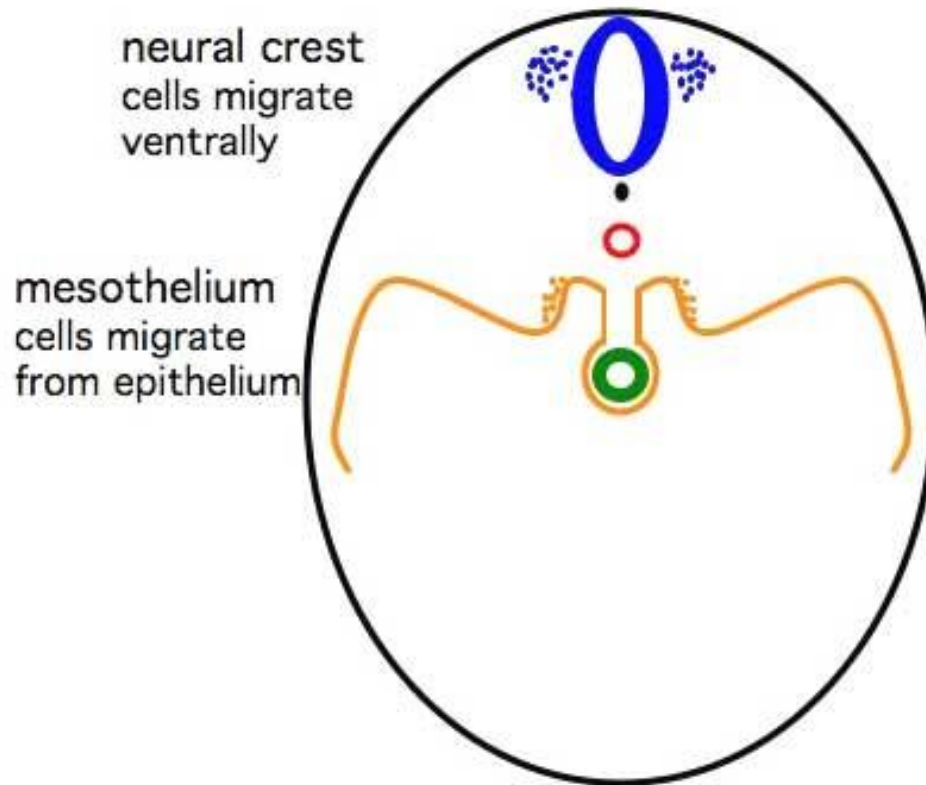
Extra adrenal chromaffin cells located to the left of aortic bifurcation near the origin of IMA

EMBRYOLOGY

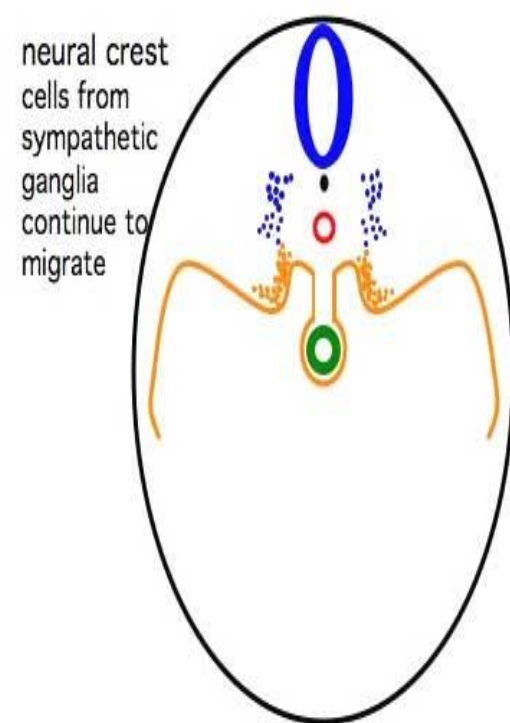
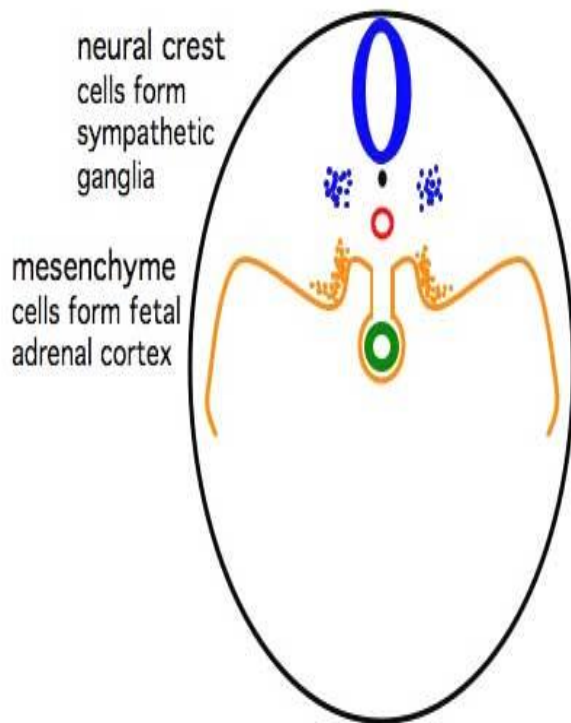
Adrenal Gland Development



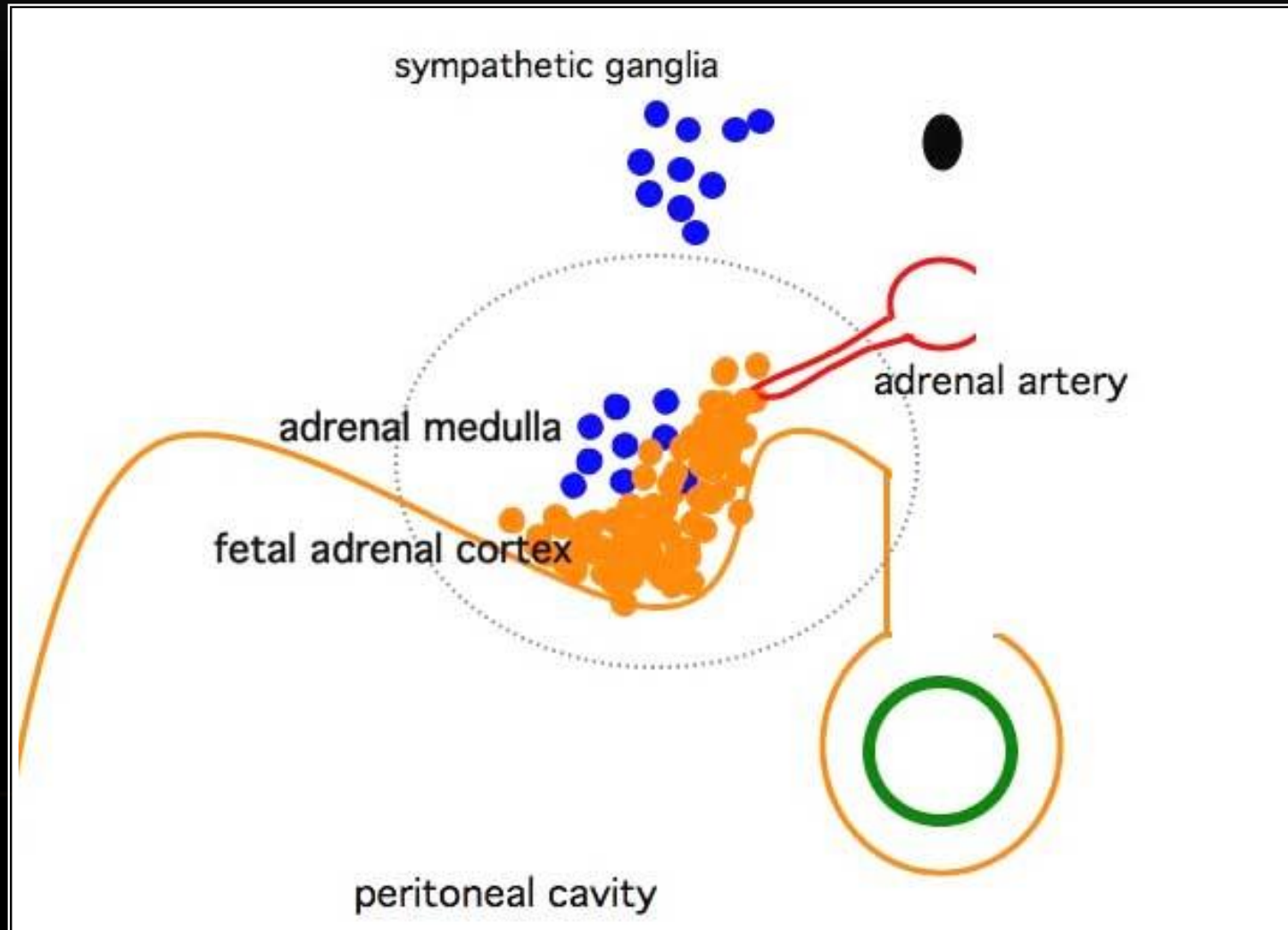
EMBRYOLOGY

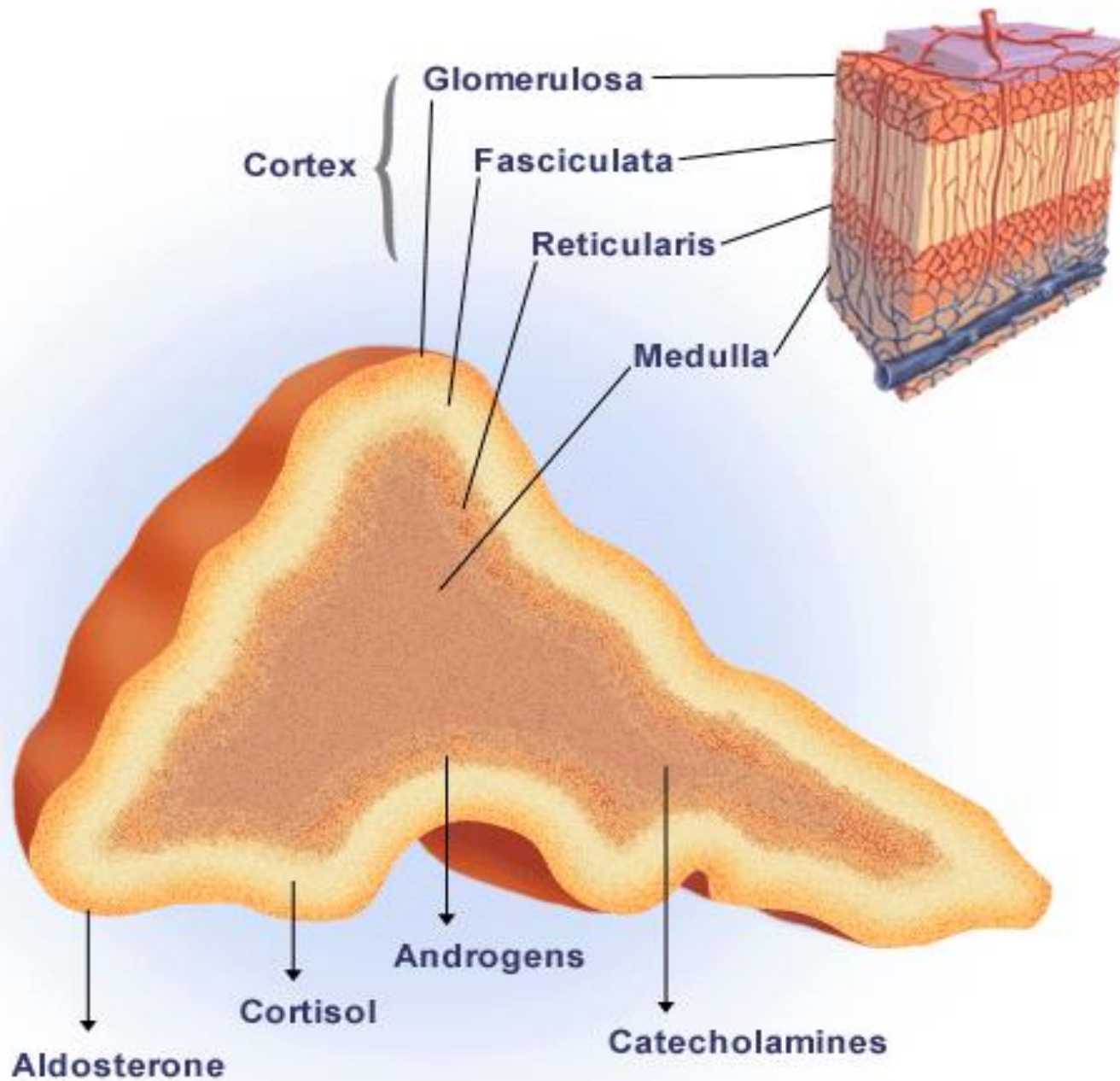


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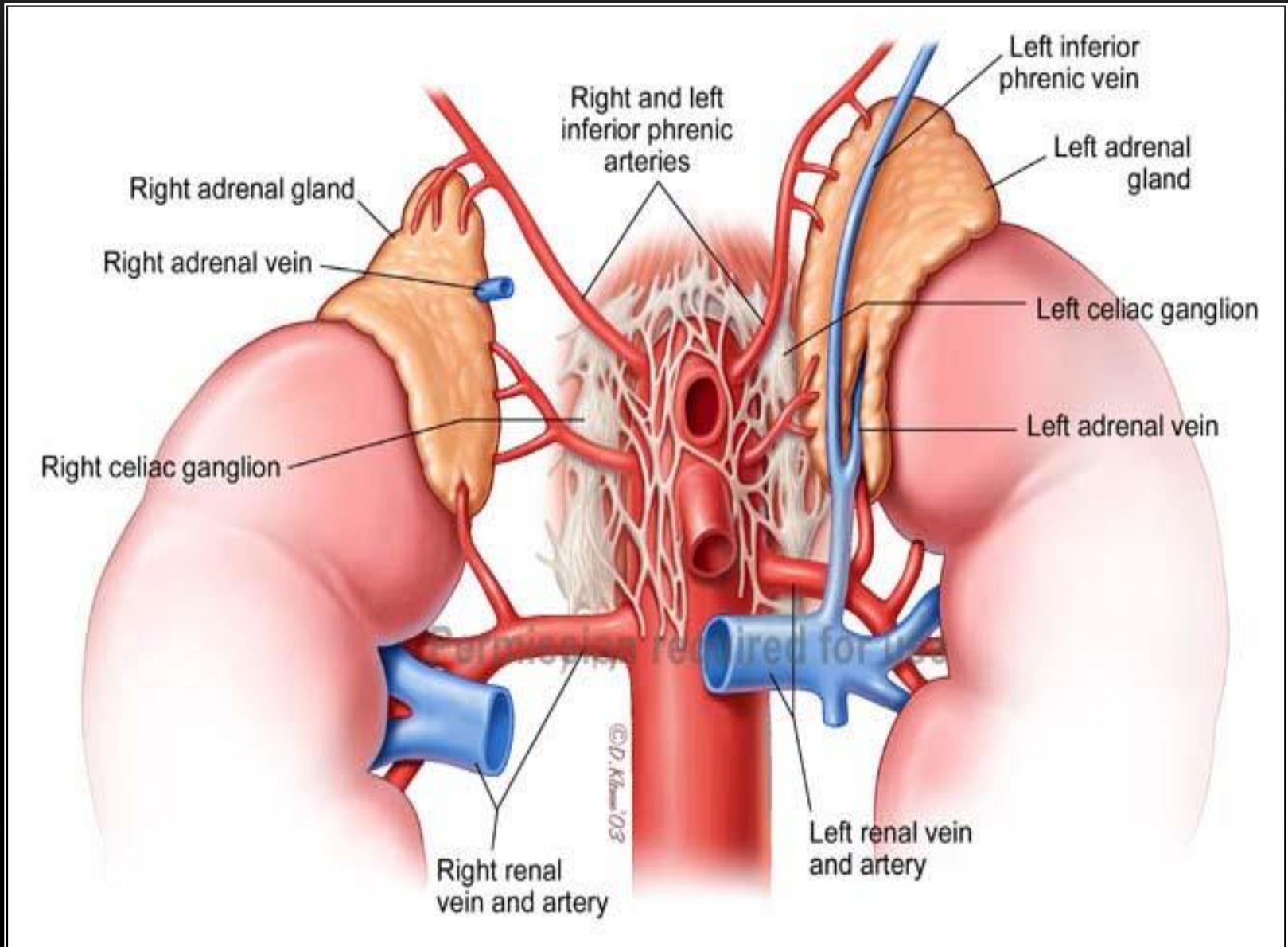


EMBRYOLOGY





VASCULAR SUPPLY



Adrenal Embryology

Composed of a cortex and medulla, which have separate embryology.

The adrenal cortex arises from the coelomic mesoderm between the fourth and sixth weeks of gestation.

Adrenal Embryology

The adrenal medulla is derived from cells of the neural crest that also form the sympathetic nervous system and the sympathetic ganglia. Some of these neural crest cells migrate into the adrenal cortex to form the adrenal medulla, but chromaffin tissue may also develop in extraadrenal sites.

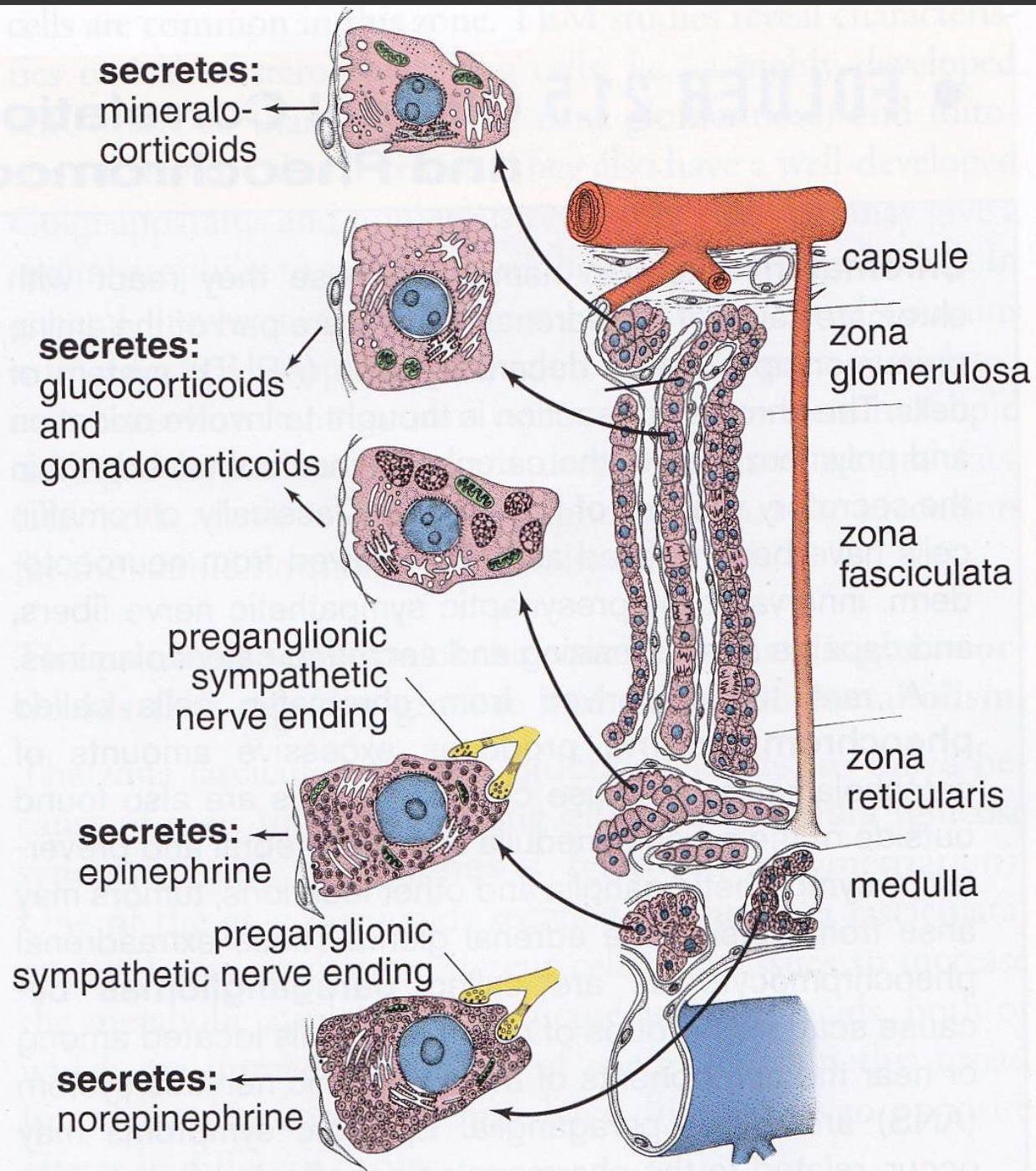
Adrenal Anatomy

Left>right

Receive arterial blood from branches of the inferior phrenic artery, aorta, and renal arteries.

The right adrenal vein is short and exits the gland medially to enter the vena cava. The left adrenal vein exits anteriorly and usually drains into the left renal vein. As a result, adrenal venous catheterization is accomplished more easily on the left than the right.

Adrenal Histology



The gland is divided into an outer cortex and an inner medulla.

The adrenal cortex is composed of three zones histologically:

- Outer zona **glomerulosa**, site for aldosterone synthesis.
- Central zona **fasciculata** produce cortisol, and
- Inner zona **reticularis** produce androgens.

Zona glomerulosa

Is the exclusive site of production of aldosterone.

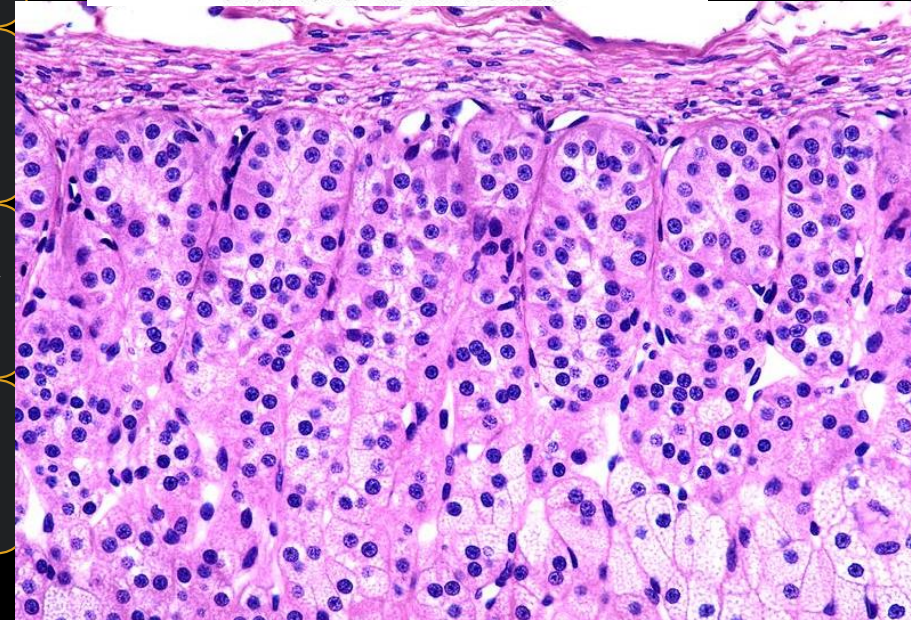
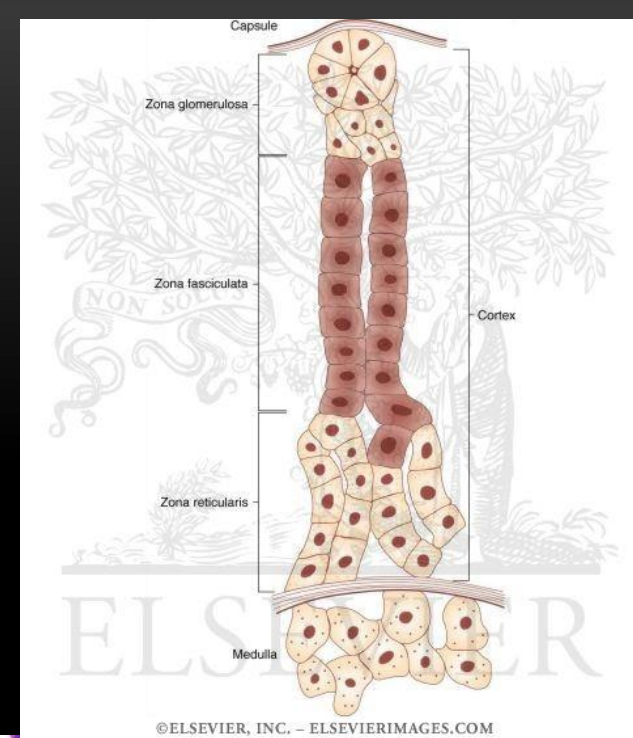
Consists ~ 15% of the cortex.

Cells are arranged in closely packed clusters continuous with the next layer.

Cells are small pyramidal-columnar with spherical nuclei.

Clusters of cells are surrounded by fenestrated sinusoidal capillaries.

Cells have abundant sER, large mitochondria with shelf-like cristae, Golgi complex, few rER, and few lipid droplets.



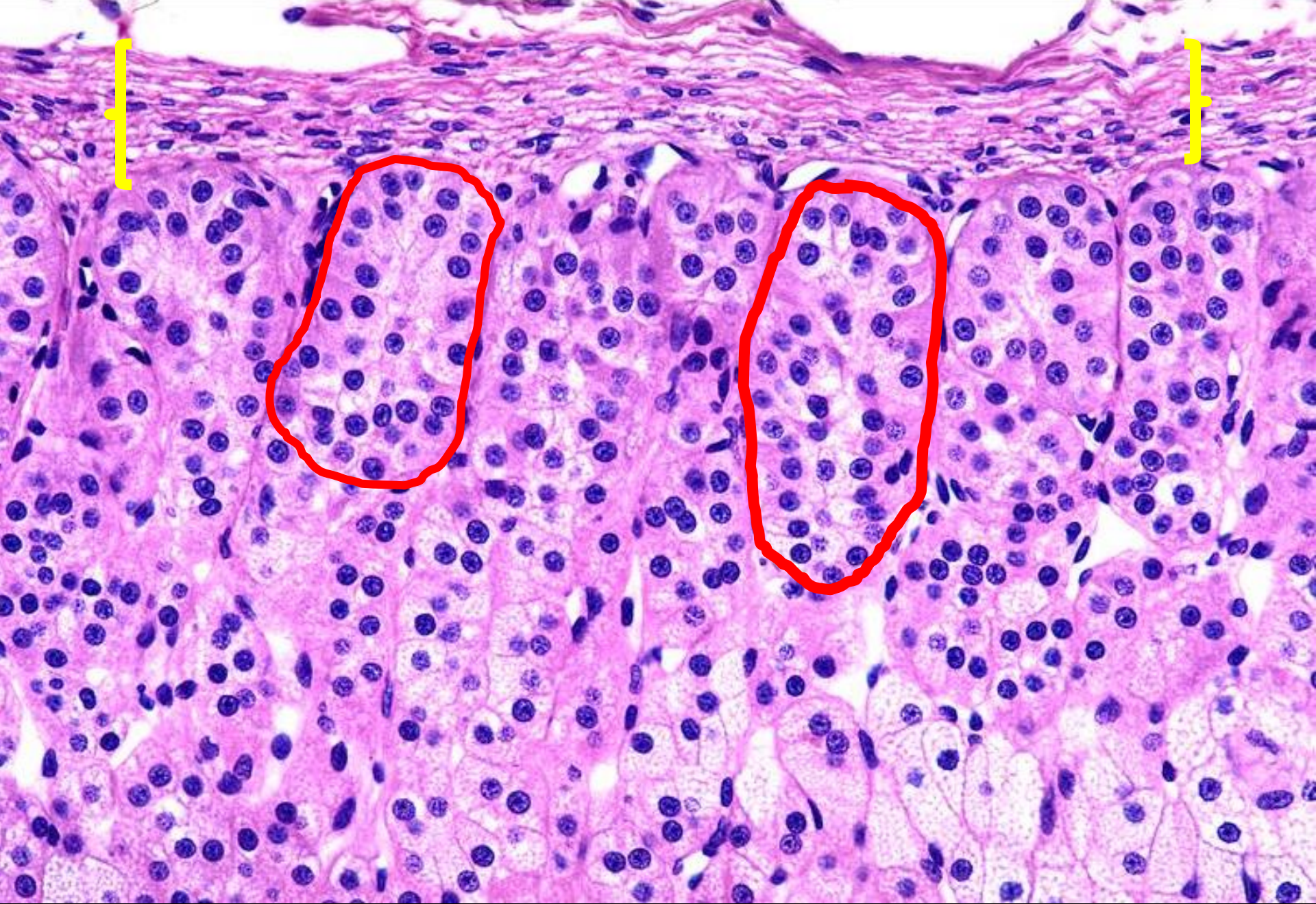
Zona glomerulosa secretes mineralocorticoids, that function in the regulation of sodium and potassium homeostasis and water balance.

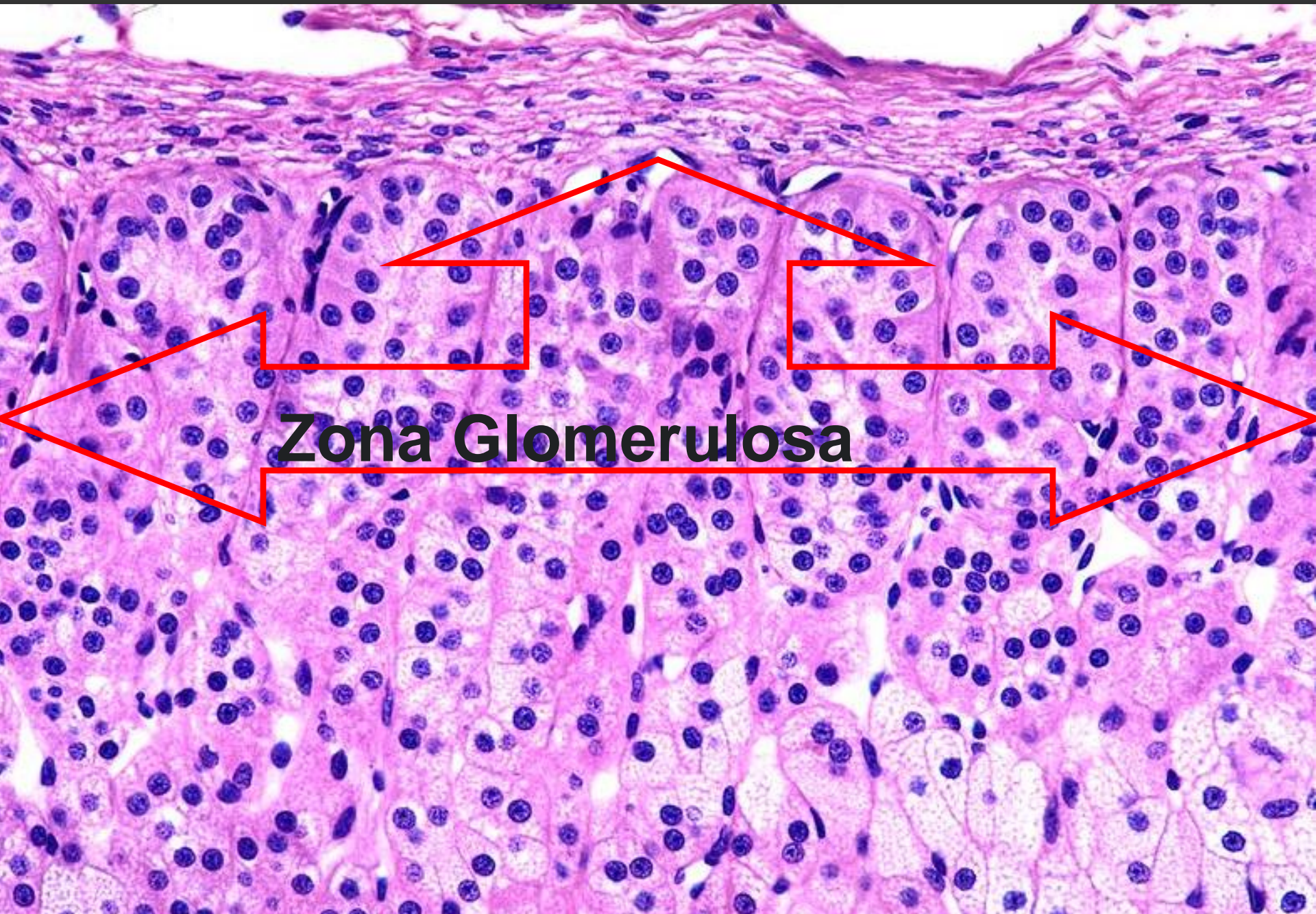
The main mineralocorticoid is aldosterone.

Aldosterone stimulates resorption of sodium from:

- Distal renal tubules.
- Gastric mucosa.
- Salivary glands.
- Sweat glands.

The zona glomerulosa is under the feed back control of the renin-angiotensin-aldosterone system.





Zona Glomerulosa

Zona Fasciculata

The thickest middle zone that form ~80% of the cortex.

Cells are large polyhedral, arranged in long straight cords 1-2 cells thick.

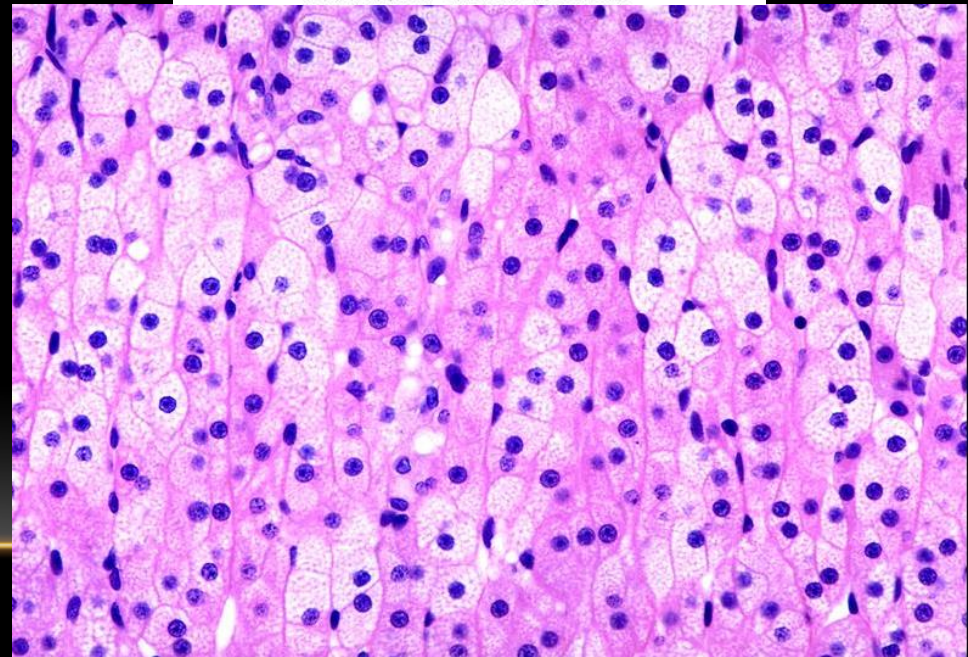
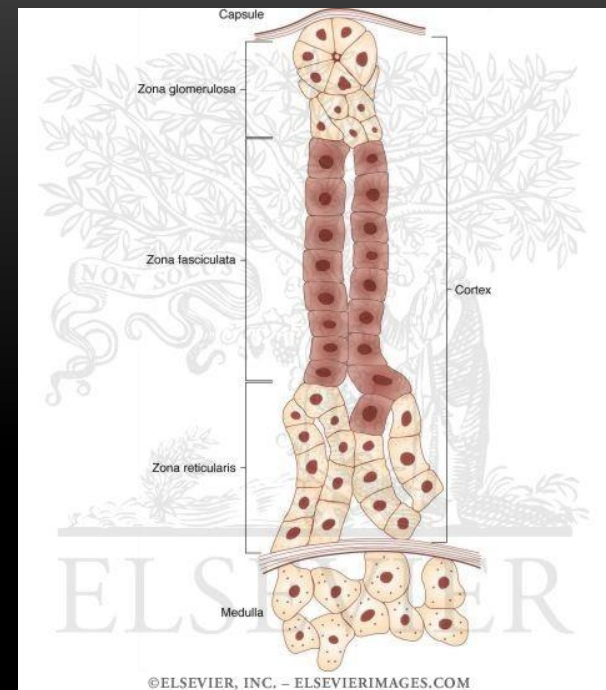
Cords are separated by sinusoidal capillaries.

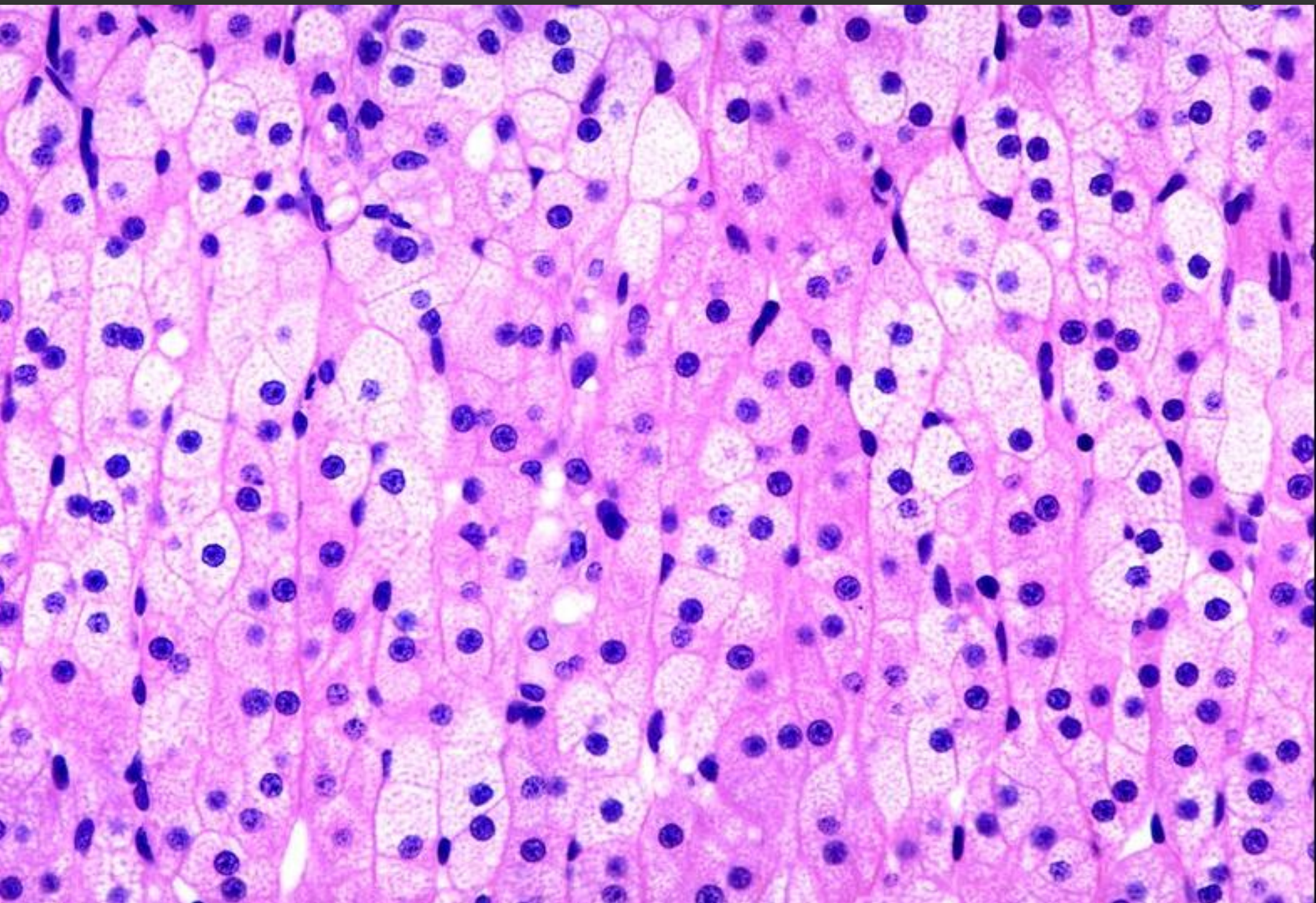
Cells are lightly stained, commonly binucleated.

Cells are typical steroid synthesizing cells.

Cytoplasm contains lipid droplets.

Cells secrete glucocorticoids, mainly cortisol.





Glucocorticoids may have different, even opposite effects in different tissues:

- In the liver:
 - ↑ conversion of aminoacids to glucose.
 - ↑ polymerization of glucose to glycogen.
 - ↑ uptake of aminoacids and fatty acids.
- In adipose tissue: ↑ breakdown of lipids to glycerol and free fatty acids.
- In other tissues: ↓ rate of glucose use and ↑ oxidation of fatty acids.
- In cells: ↓ protein synthesis and ↑ protein catabolism.

Zona reticularis

The inner zone, forms 5-7% of the cortex. Contains light and dark cells.

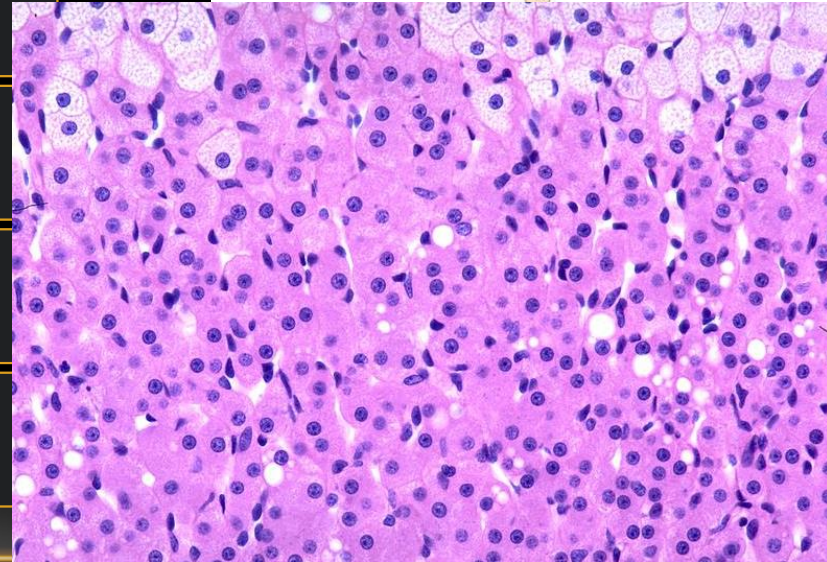
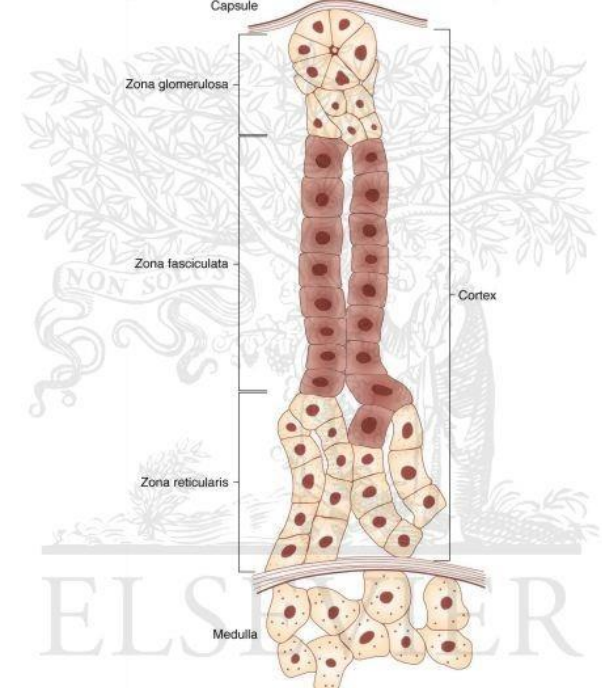
Cells are smaller than the reticularis, their nuclei are more deeply stained.

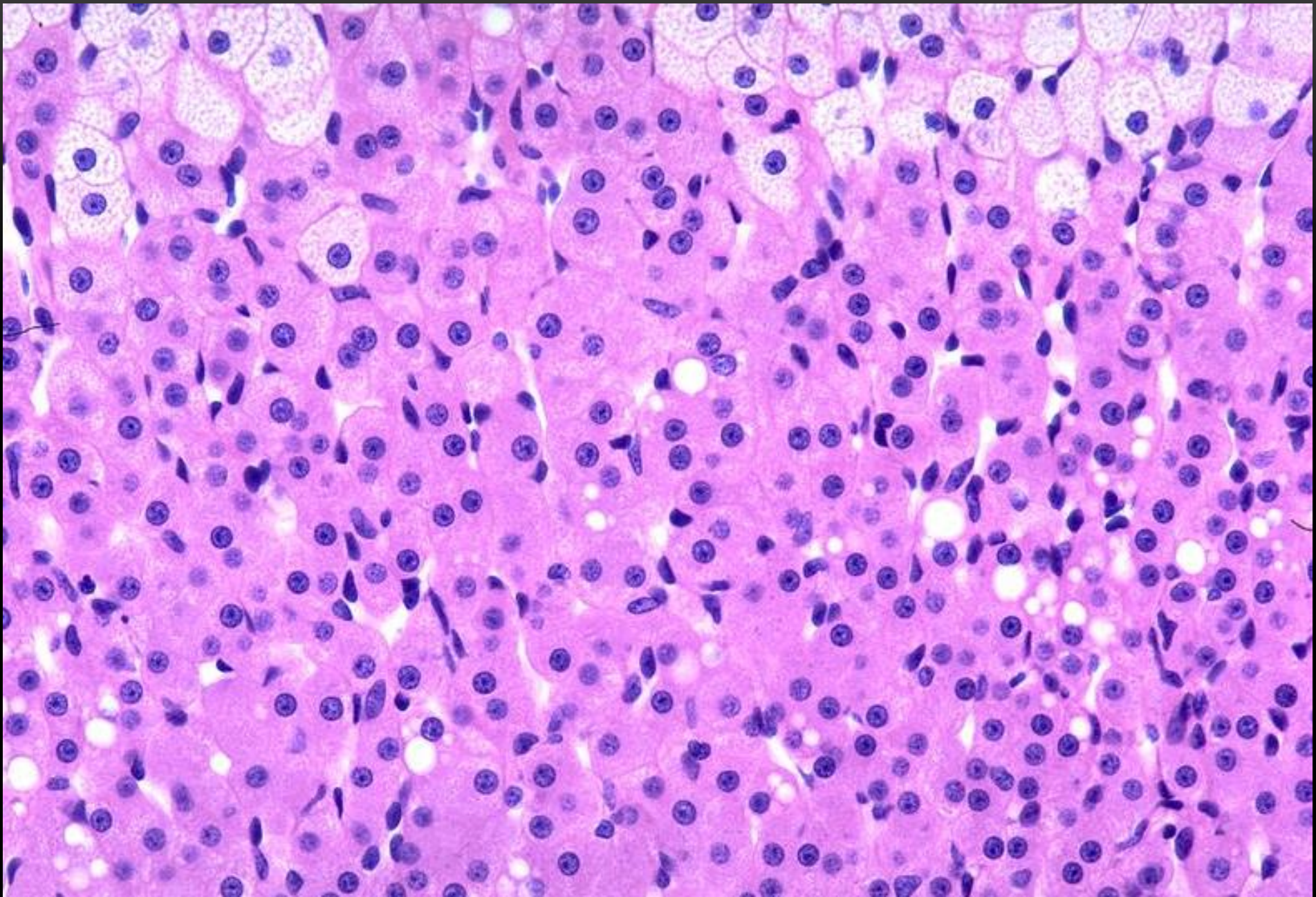
Cells are arranged in anastomosing cords separated by fenestrated capillaries.

Cells have few lipid droplets.

Cells are typical steroid-secreting cells.

Their principal secretion is weak androgen (minimal glucocorticoids).



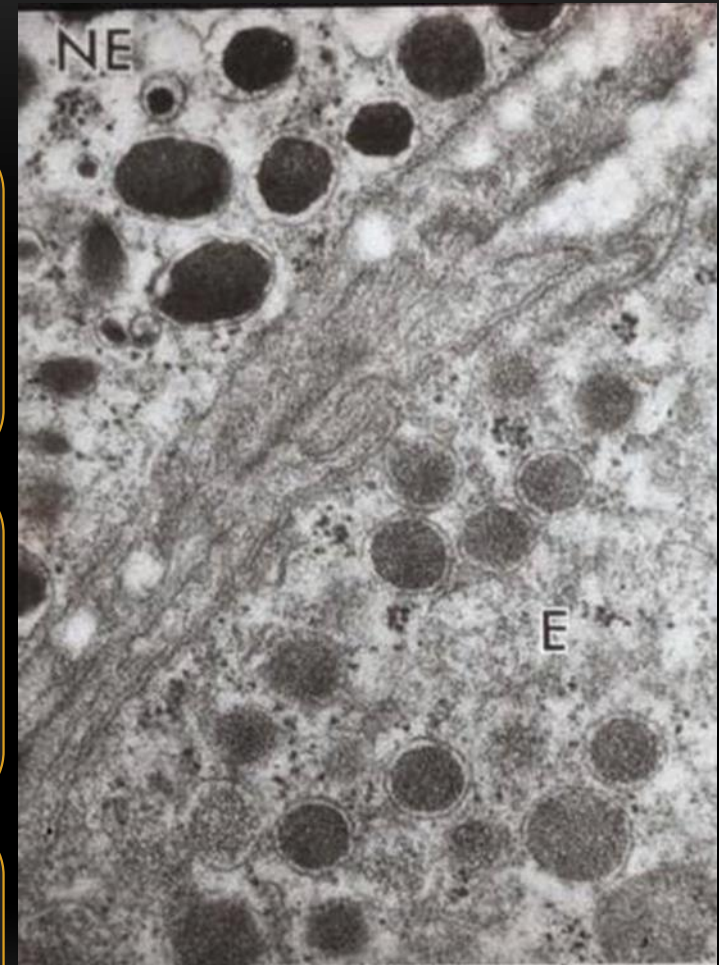


Adrenal medulla

Composed of large, pale staining epithelioid cells; chromaffin cells, connective tissue, sinusoidal capillaries and nerves.

The chromaffin cells are modified neurons.

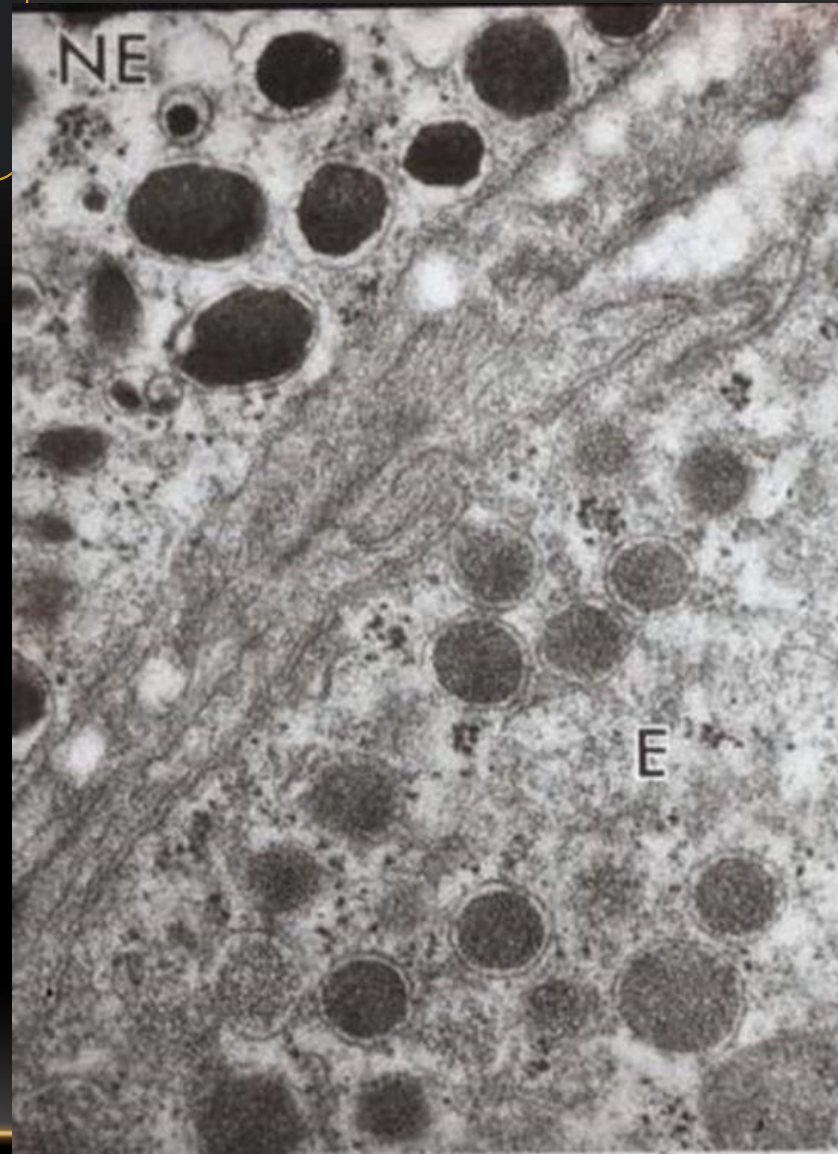
Myelinated, presynaptic nerves pass directly to chromaffin cells.



Chromaffin cells

E.M shows that there are two types of chromaffin cells:

- Cells containing large dense core vesicles → secrete norepinephrine.
- Cells containing small homogeneous less dense vesicles → secrete epinephrine.



Glucocorticoids secreted in the cortex induce the conversion of norepinephrine to epinephrine in chromaffin cells.

Most of chromaffin cells at the cortico-medullary junction secrete epinephrine.

The catecholamines, in concert with the glucocorticoids, prepare the body for the “fight-or-flight” response.

Sudden release of catecholamines establishes conditions for maximum use of energy.

