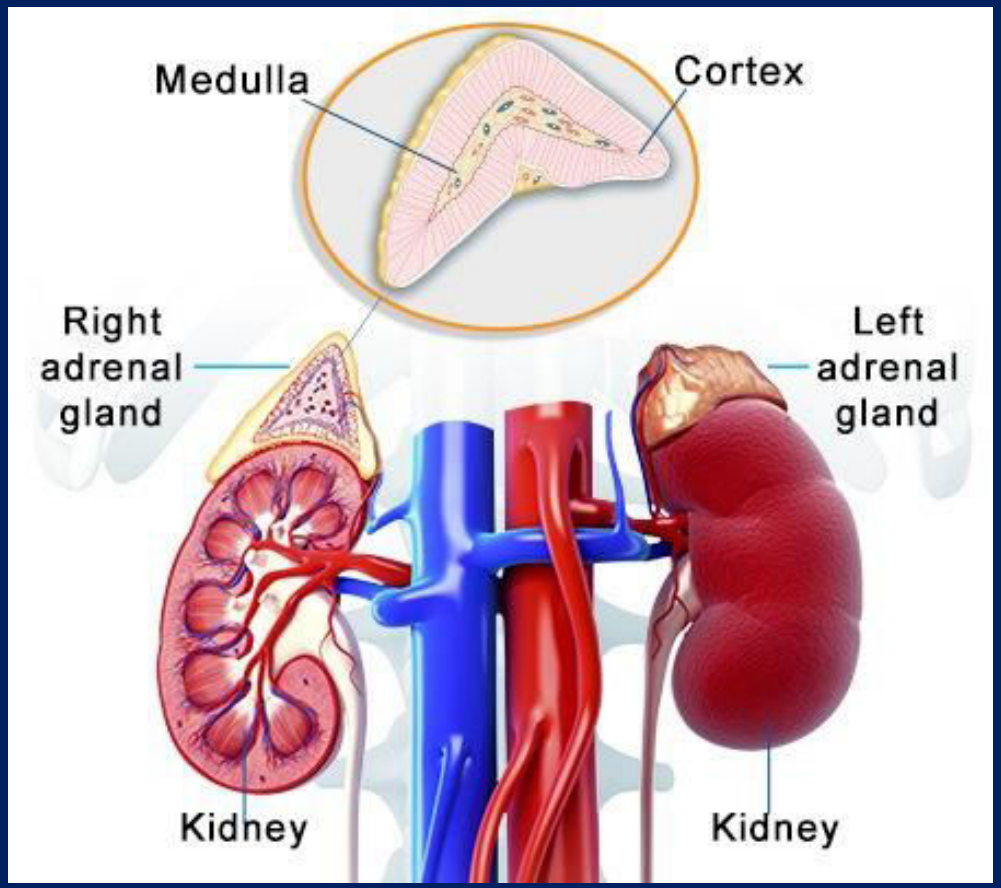
The Adrenal gland (Supra renal gland)

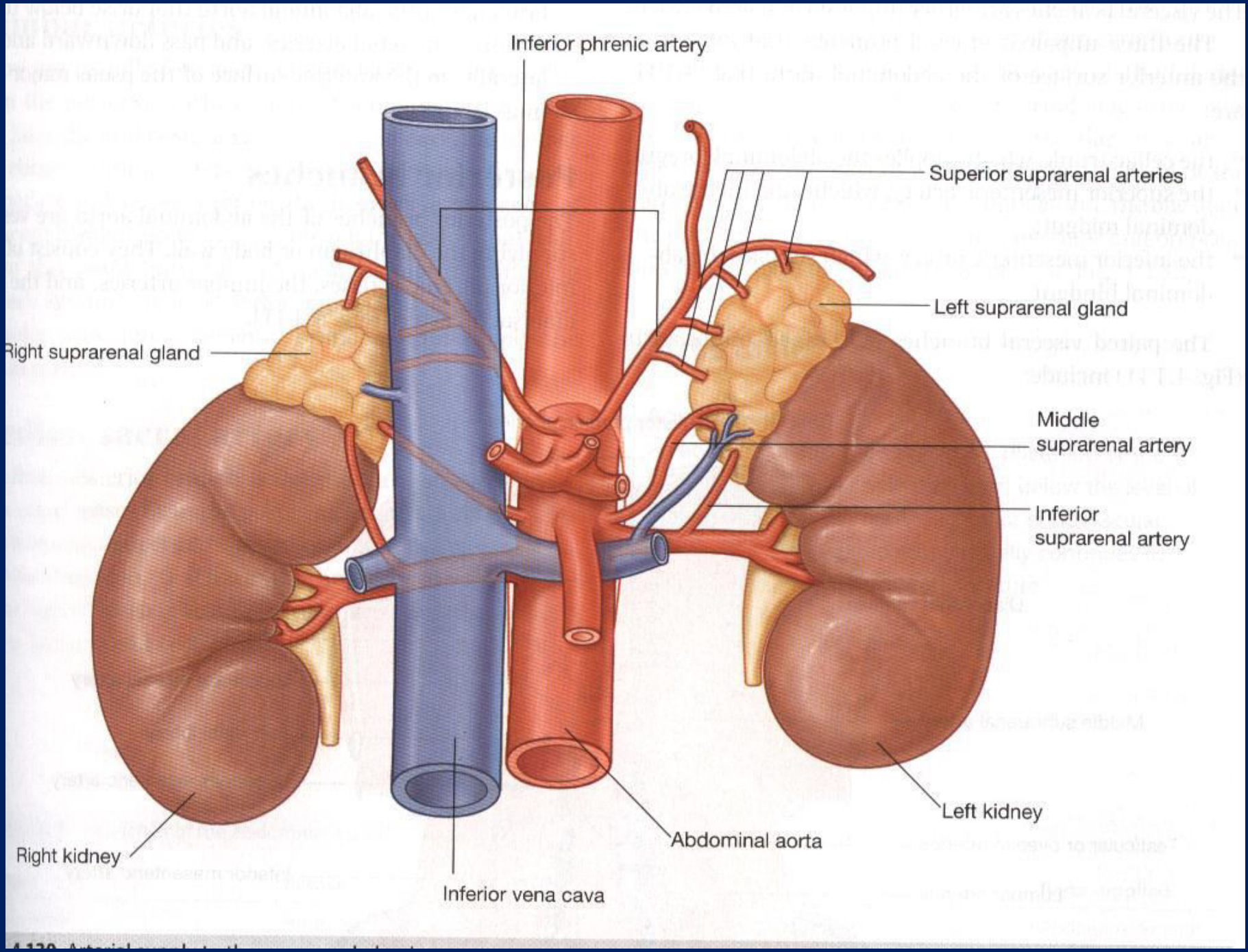
Learning outcomes

- State the anatomical location of the adrenal gland.
- State the morphological features (size, shape) immediate relations of the right and left glands.
- State the differences between the two glands.
- Describe the microscopic structure of the gland.
- State the hormones secreted by the gland.
- State the blood supply and nerve supply of the gland

Anatomical location

- Paired asymmetrical glands
- Situated in the posterior abdominal wall (retroperitoneal)
- Upper pole of the kidneys in front of the crus of the diaphragm
- Opposite the vertebral end of the 11th ICS and the 12th rib
- Lies within own compartment of renal fascia and perinephric fat

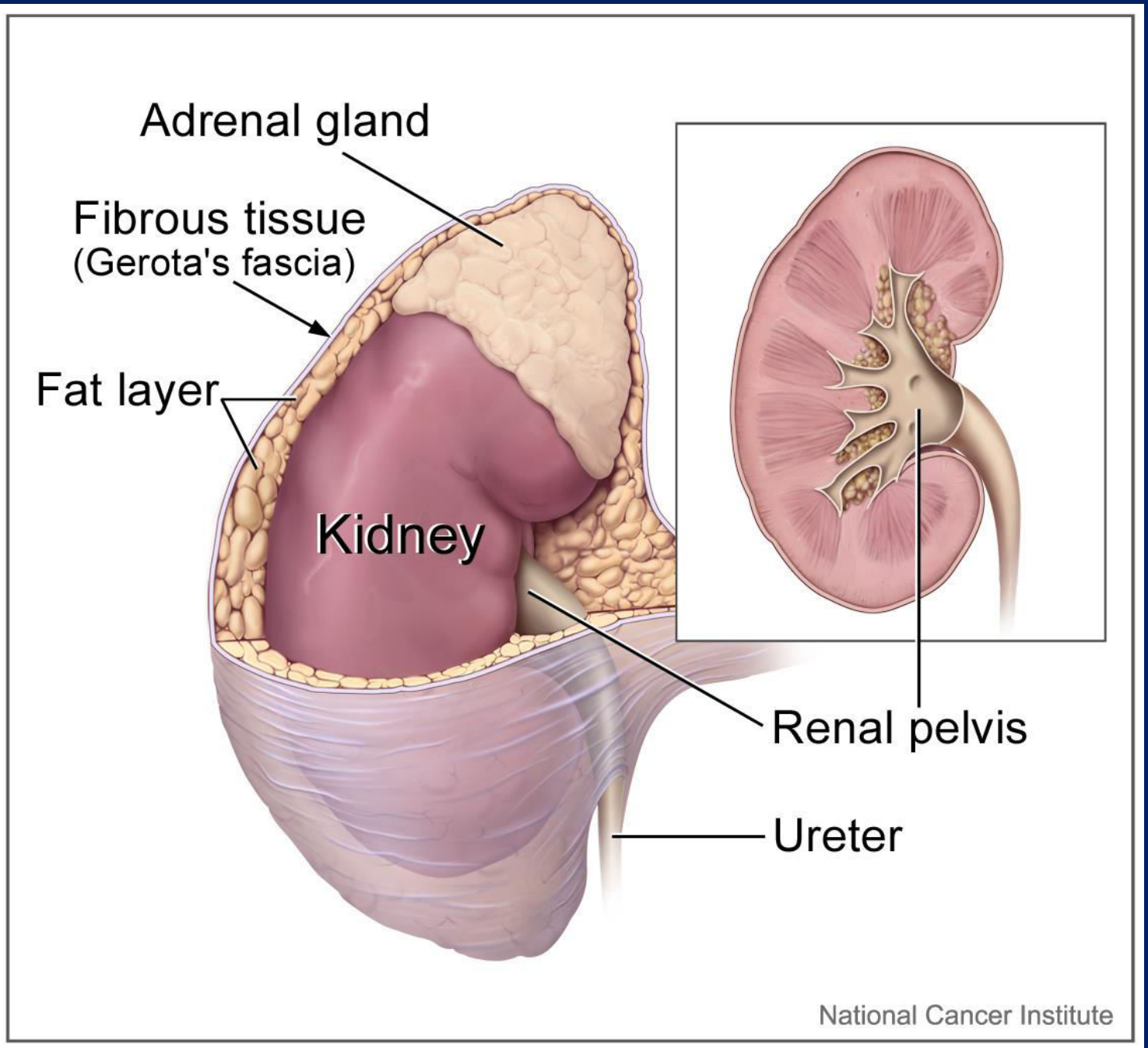



Inferior phrenic artery
Superior suprarenal arteries
Left suprarenal gland
Right suprarenal gland
Middle suprarenal artery
Inferior suprarenal artery
Left kidney
Abdominal aorta
Right kidney
Inferior vena cava

Common features

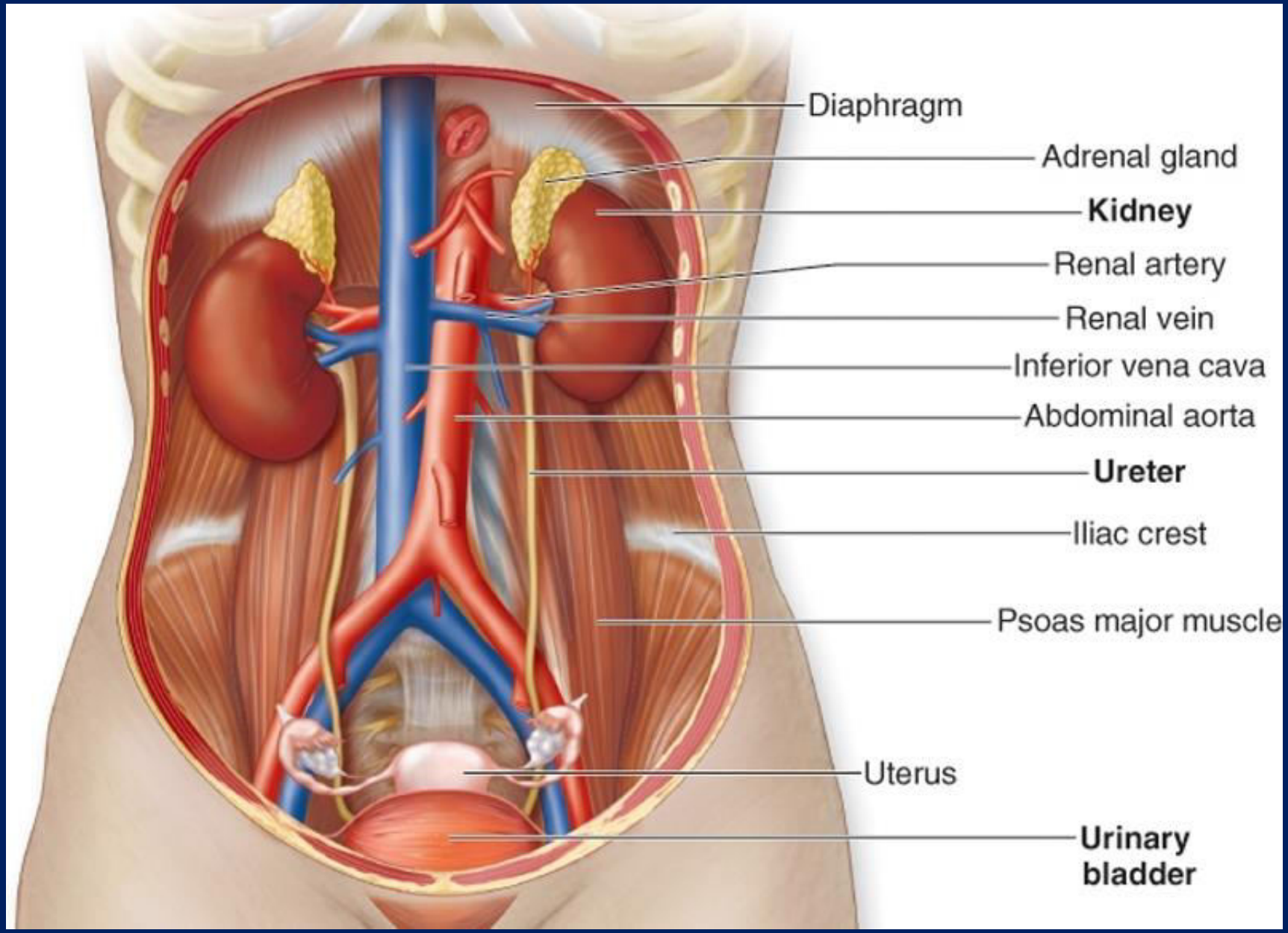
- At superior poles of the kidneys as a retroperitoneal structure
- Each gland measured- 50x30x10mm
- 1/3 of size of kidney

  at birth → 1/30 of it in an adult
- Wt – 3- 4g
- Cortex/medulla
- Three arterial supply and single vein drainage
- Immediately covered by areolar tissue and fat and outside it perirenal fascia. – Gerota's fascia
- Perirenal fascia is a two layered sheath encroach the gland. The two layers are not fused above the gland


Adrenal gland
Fibrous tissue
(Gerota's fascia)
Fat layer
Kidney
Renal pelvis
Ureter
National Cancer Institute

Right adrenal gland

- Triangular/pyramidal shape
- Has
  - Apex
  - A base
  - Two surfaces- anterior and posterior
  - Three borders- anterior, medial and lateral
- Relations:
  - Apex- bare area of the liver
  - Base- upper pole of right kidney
  - **Anterior surface- IVC, right lobe of the liver**
  - Posterior surface- right crus of diaphragm
  - Anterior border- hilum and short and wide right supra renal vein emerging from here
  - Medial border- Coeliac ganglion
  - Lateral border- Liver

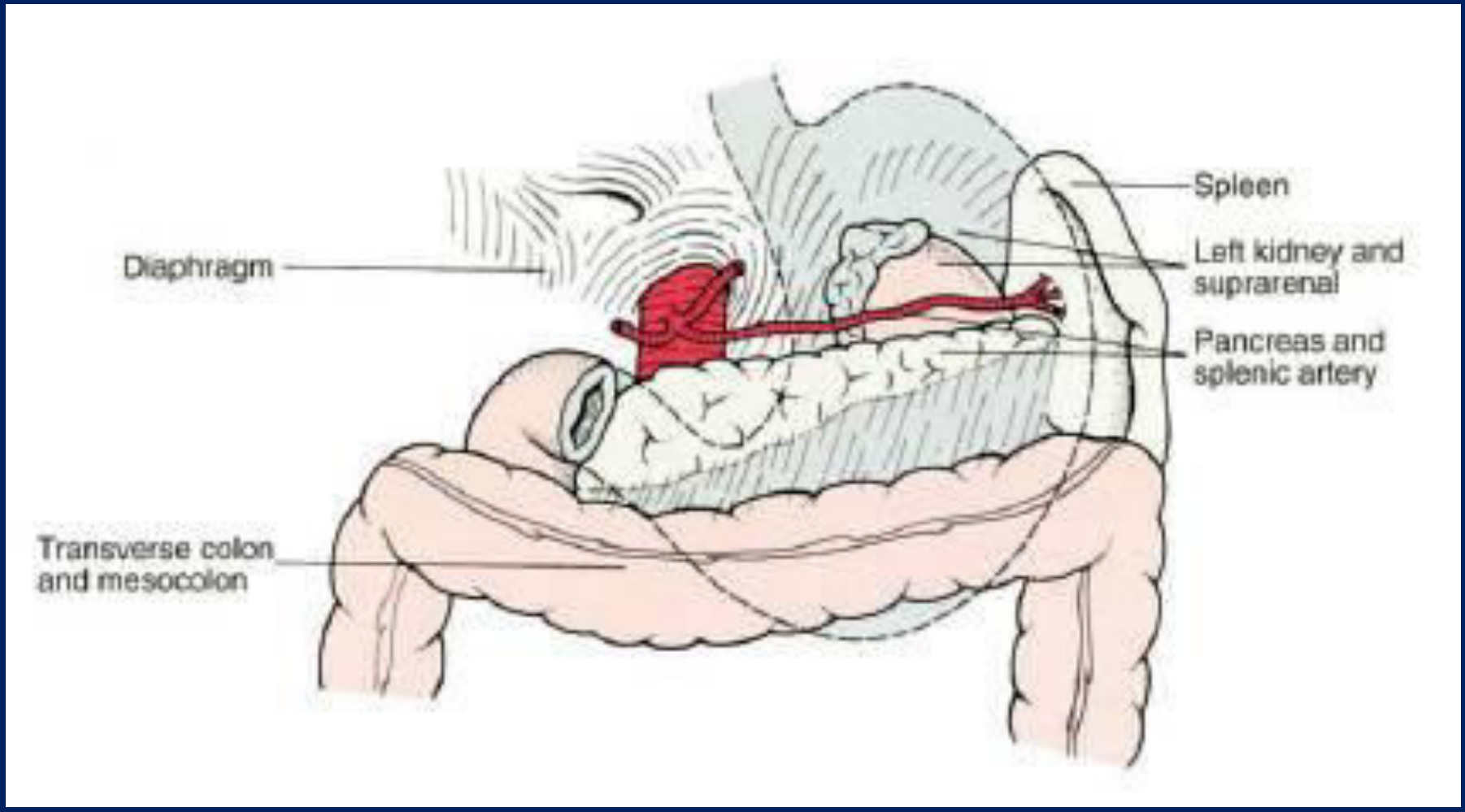

Diaphragm
Adrenal gland
Kidney
Renal artery
Renal vein
Inferior vena cava
Abdominal aorta
Ureter
Iliac crest
Psoas major muscle
Uterus
Urinary bladder

Left adrenal gland

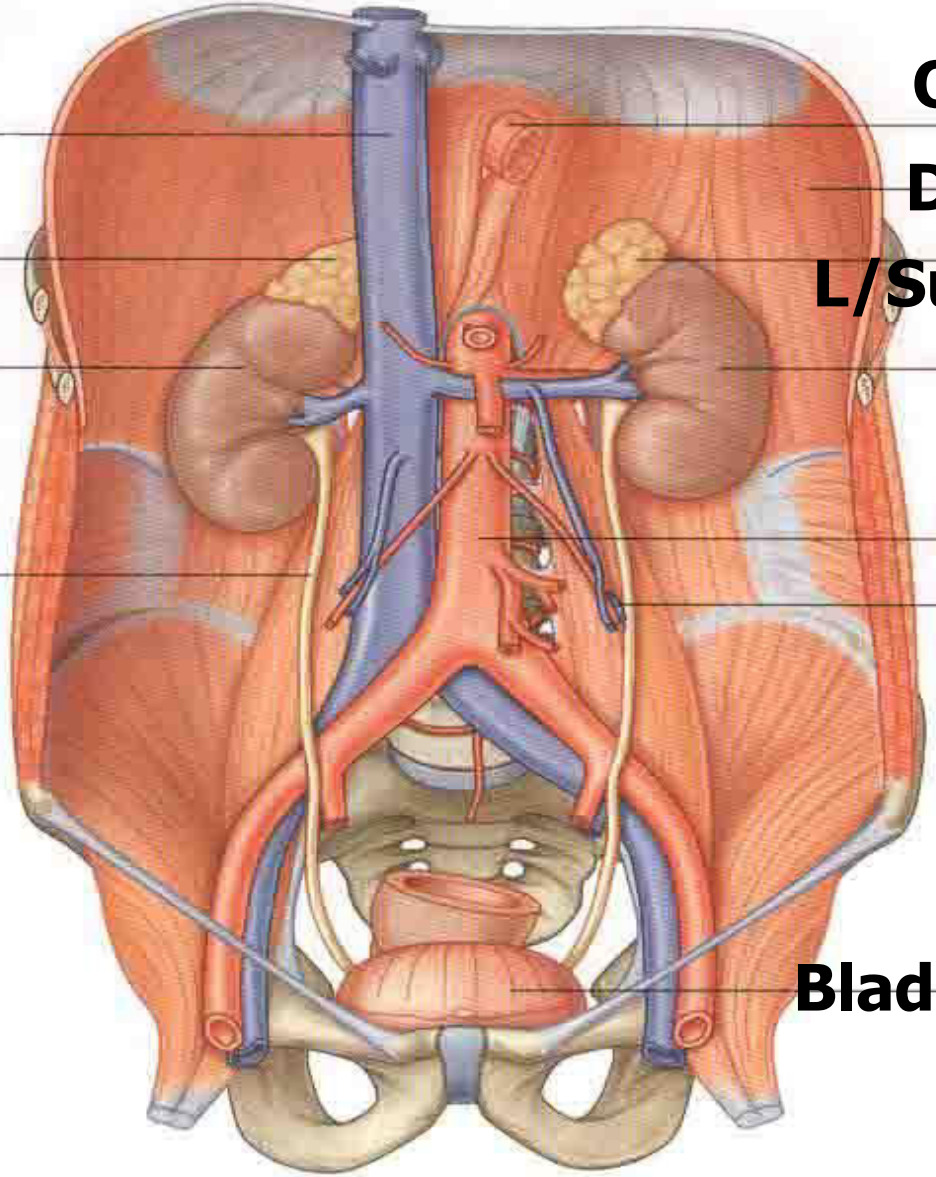
- Semilunar shape
- Has Two ends- upper(narrow) and lower(rounded)
  Two surfaces- anterior and posterior
  Two borders- medial convex and lateral concave

- Relations:
  - Upper end- close to spleen
  - Lower end- hilum and left supra renal vein emerging from here
  - **Anterior surface- cardiac end of stomach across the lesser sac, pancreas with splenic artery**
  - Posterior surface- left crus of diaphragm, left kidney
  - Medial border- Coeliac ganglion
  - Lateral border- Stomach

Stomach Bed


Spleen
Diaphragm
Left kidney and suprarenal
Pancreas and splenic artery
Transverse colon and mesocolon

Posterior Abdominal wall in relation to supra-renal



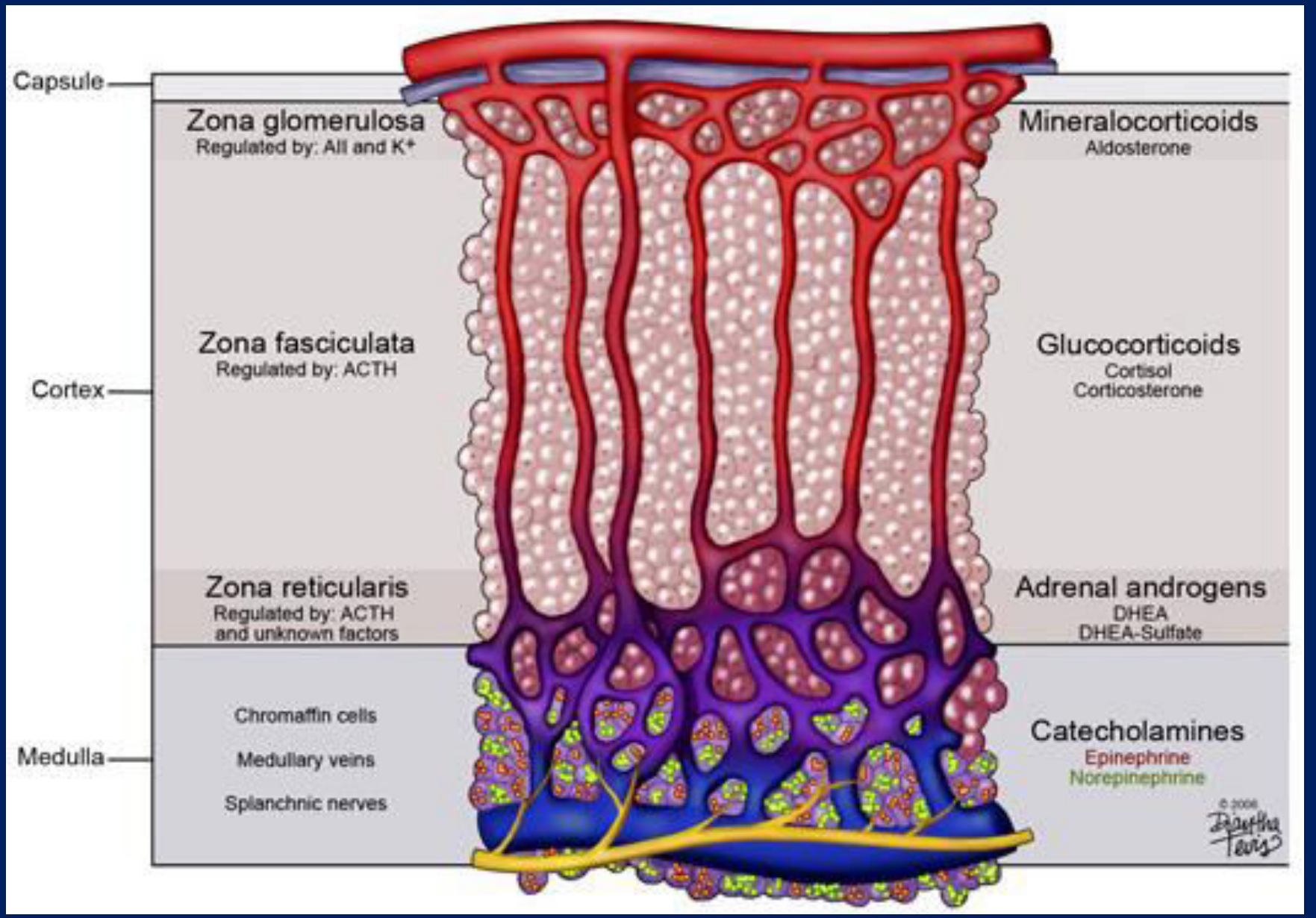
Microscopic structure of the gland

- Cross section has outer *cortex* and inner *medulla*
- Two parts differ from each other from *structurally, functionally* and *developmentally (*Cortex-intermediate mesoderm, Medulla- neural crest cells)

- Cortex:
  - Zona glomerulosa(outer)- **mineralocorticoids**
  - Zona fasciculate (middle)- **glucocorticoids**
  - Zona reticularis (inner)- **sex hormones**

- Medulla: c/o chromaffin cells
  - secrete adrenalin and noradrenaline
  - lots of capillaries

Structure of the gland



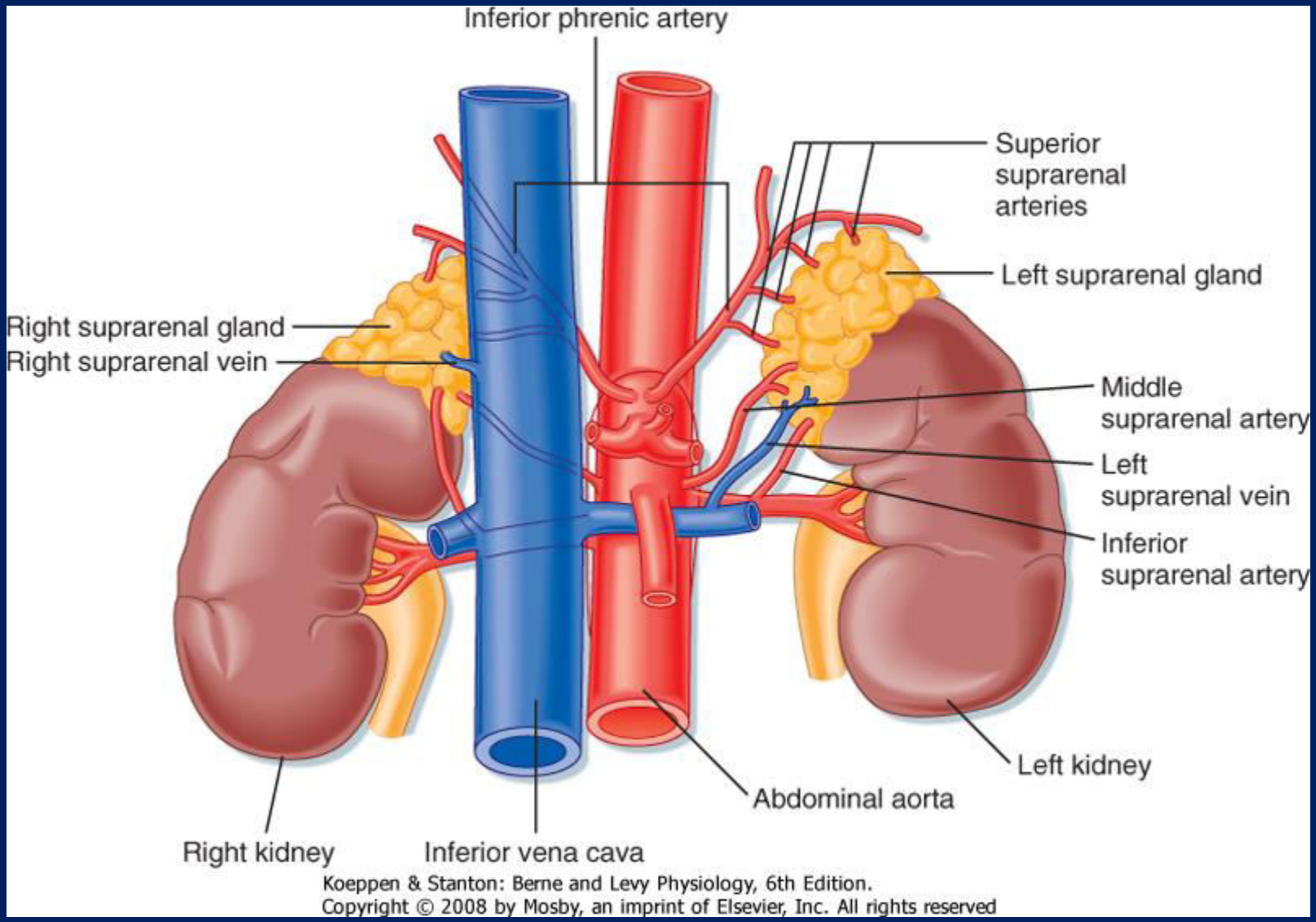
Blood supply of the gland

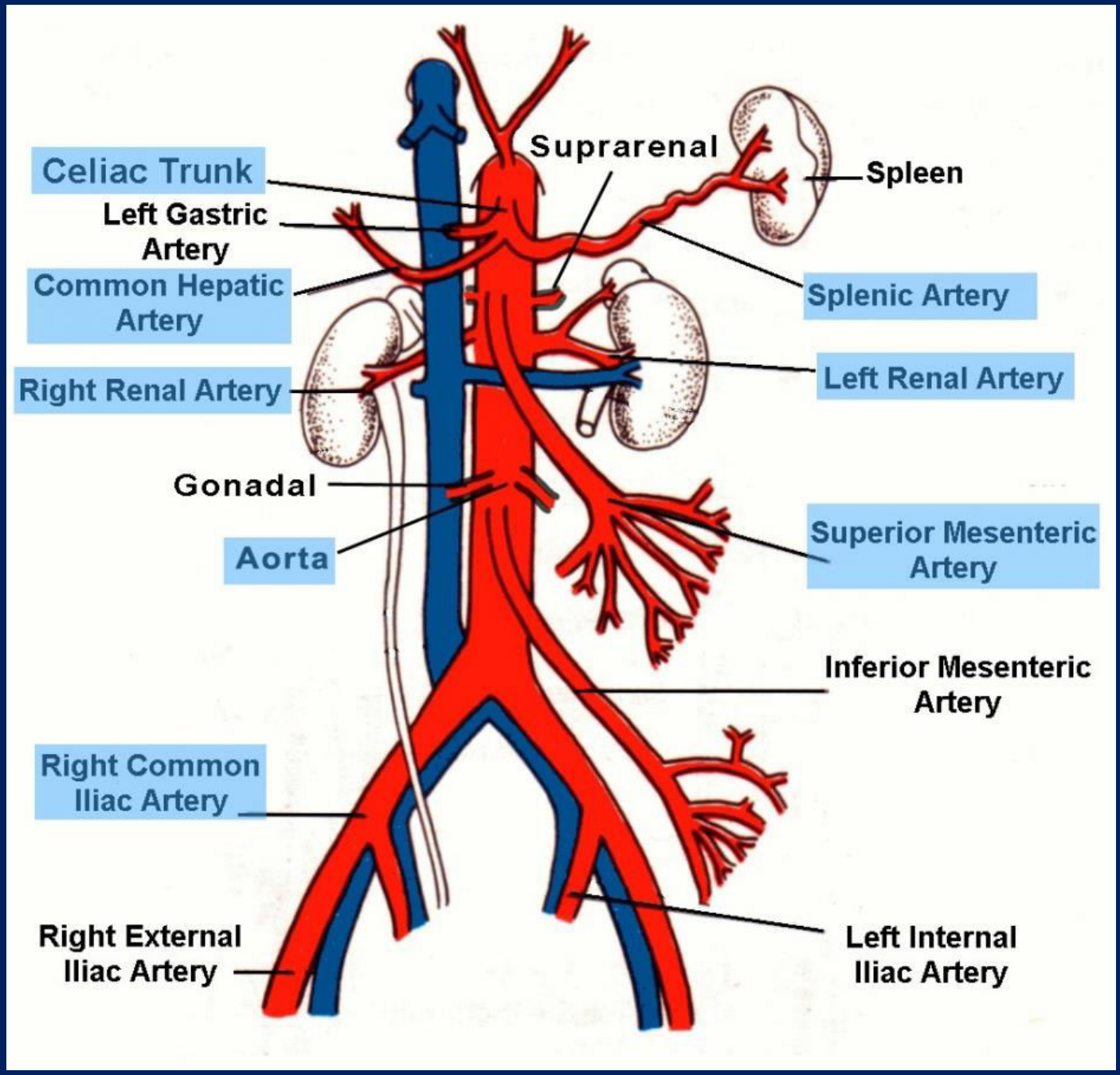
Arterial

Three main groups

- Superior suprarenal ← Inferior phrenic A.
- Middle suprarenal ← Aorta
- Inferior suprarena← Renal A.
- Enter at various points around the periphery(branches can be divided into three groups)
- ***Venous***
- Each gland is drained by one vein
- Right suprarenal (stubby) - IVC
- Left suprarenal- left renal vein

Blood supply of the gland




Celiac Trunk
Left Gastric Artery
Common Hepatic Artery
Right Renal Artery
Gonadal
Aorta
Suprarenal
Spleen
Splenic Artery
Left Renal Artery
Superior Mesenteric Artery
Inferior Mesenteric Artery
Right Common Iliac Artery
Right External Iliac Artery
Left Internal Iliac Artery

Blood supply of the gland

Arterial branches -3 groups

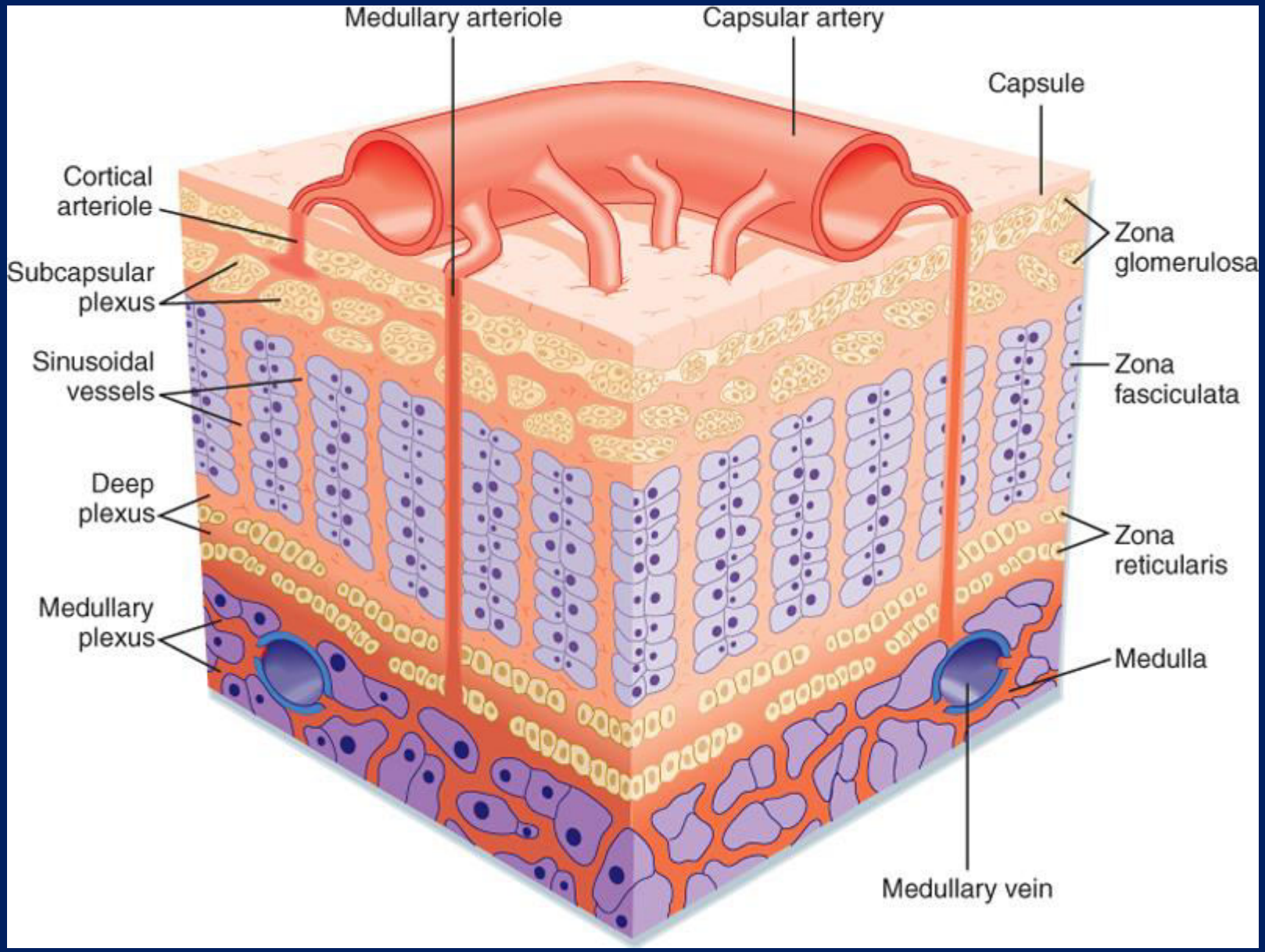
- ***arteries to capsule***
- ***Arteries/arterioles to cortex*** branching into a capillaries and sinusoids, irrigate the adrenal cortical cells, eventually drain into the medulla
- ***Arteries/arterioles to medulla-*** penetrate directly to medulla and form a network of fenestrated sinusoids
- Cells of medulla are bathed with arterial blood from medullary arteries and venous blood originating from capillaries of the cortex

- Therefore medulla has a dual supply

Blood supply of the gland

- Capillaries of the medulla and capillaries that supply the cortex form the medullary veins
- Medullary veins joins to form the suprarenal vein

Blood supply of the gland



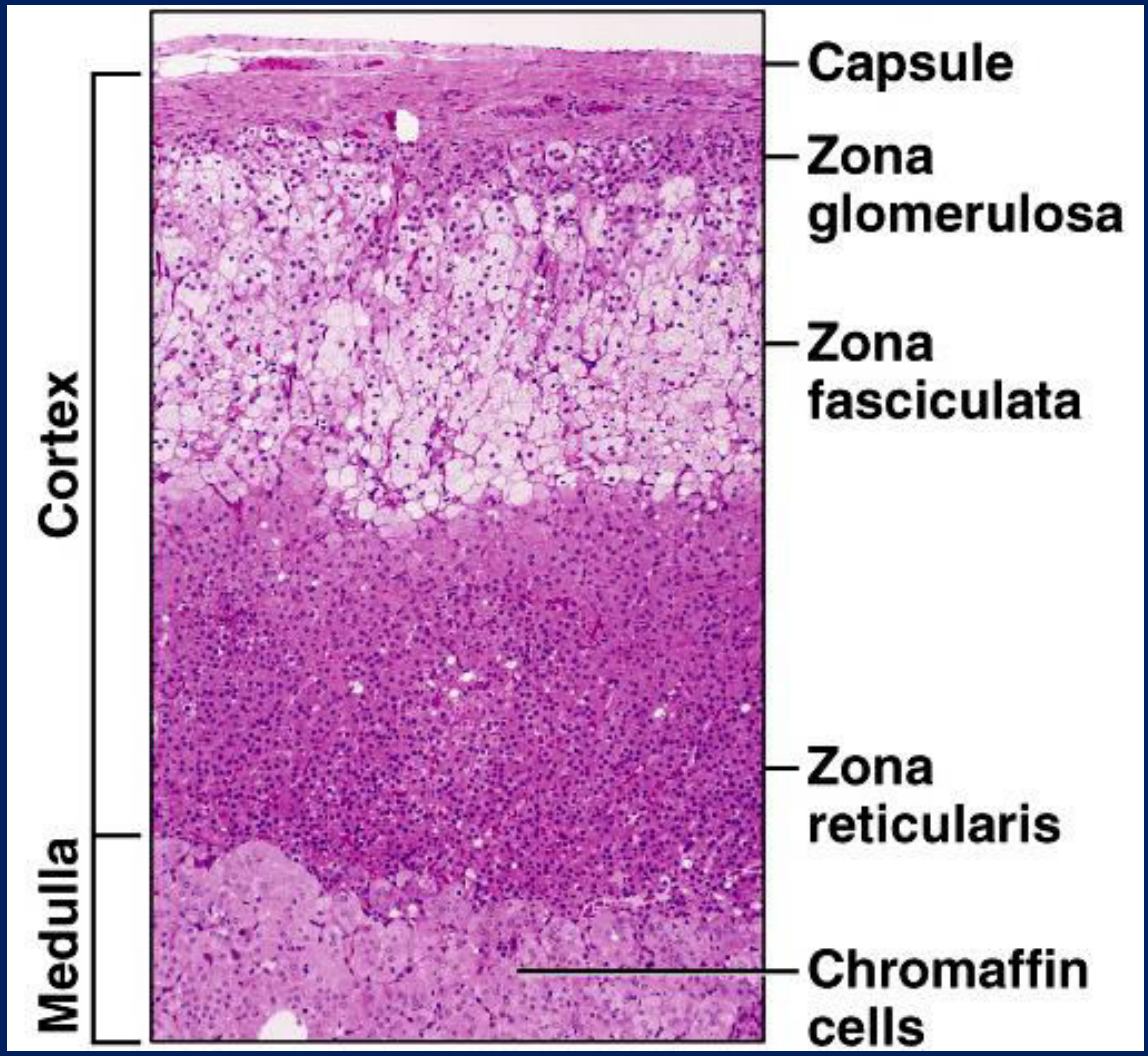
Nerve supply and lymphatics

- **Nerve supply:**
  - Medulla- through myelinated preganglionic sympathetic fibres
  - Chromaffin cells are considered homologous with postganglionic neurons

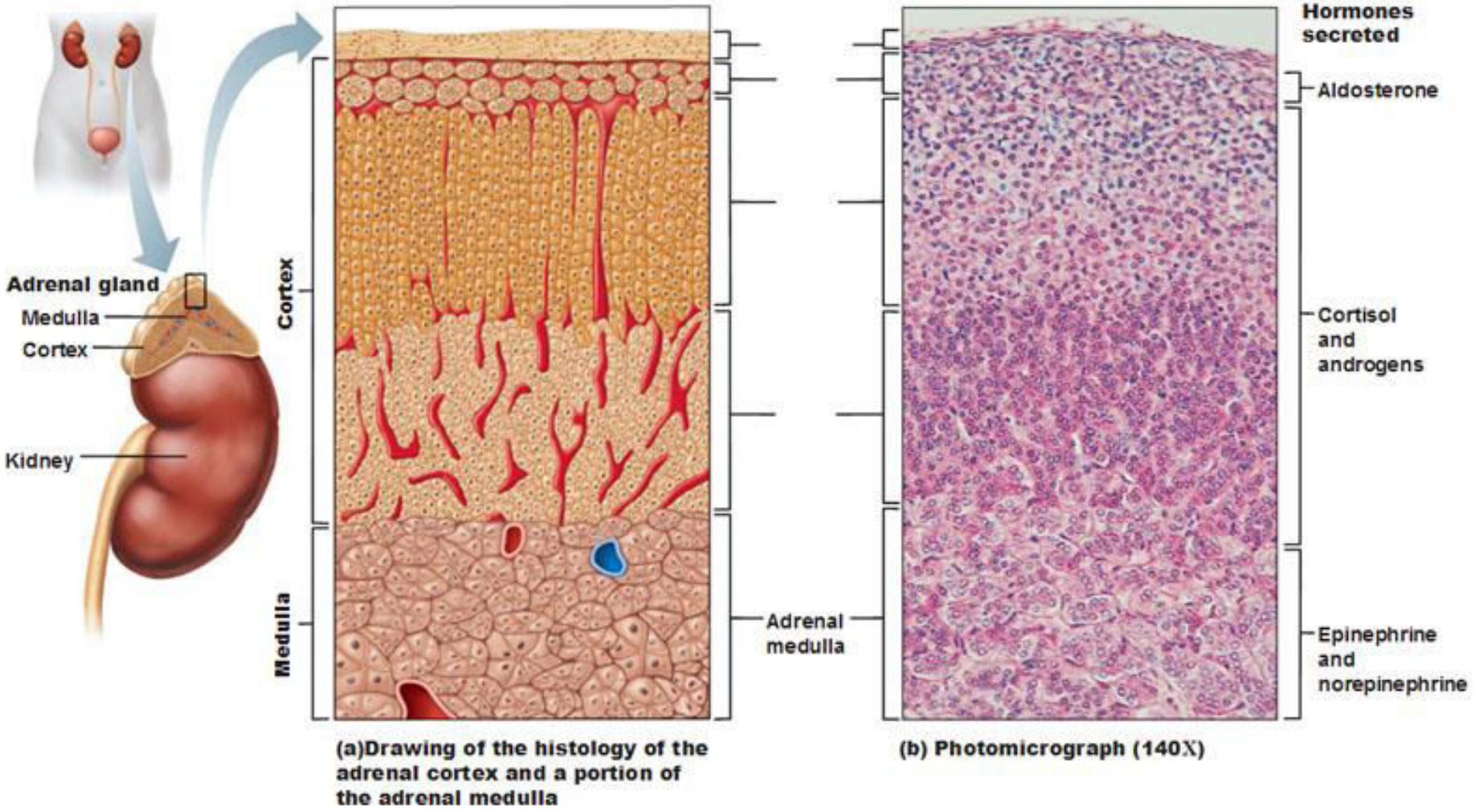
- **Lymphatics :**
  - Drains into the lateral aortic nodes

Microscopic structure

- **Cortex**
- Based on disposition and appearance of cells - 3 concentric layers –
- Zona glomerulosa -15%
- Zona fasciculata – 65-80%%
- Zona reticularis - 10%
- Cells arranged in cords along capillaries



The Adrenal Gland–Gross and Microscopic



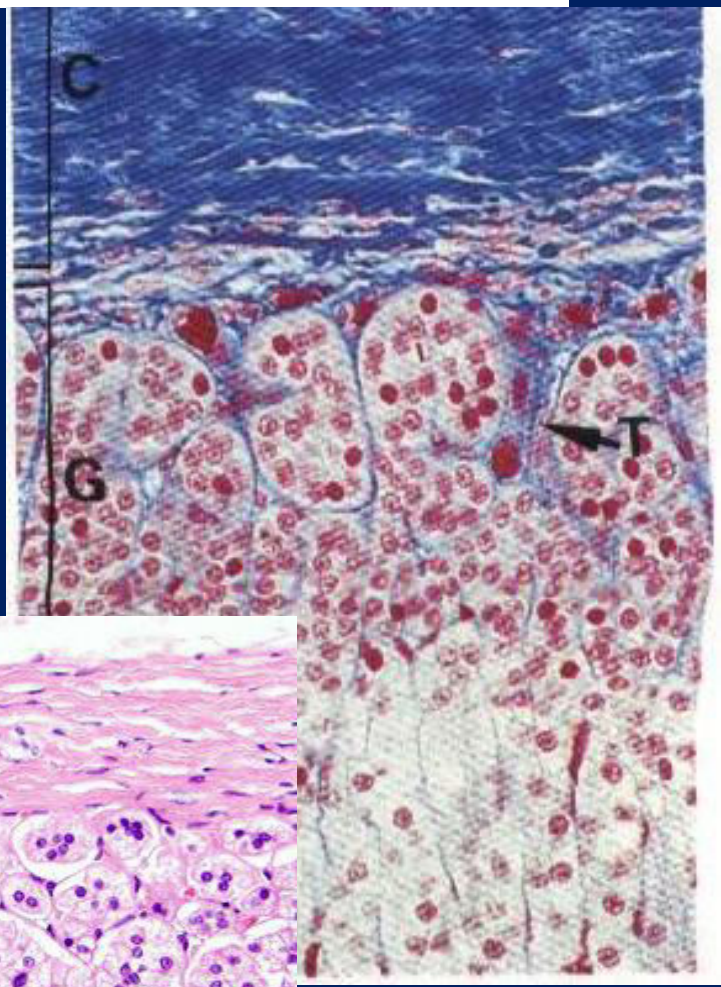
Cells – adrenal cortex

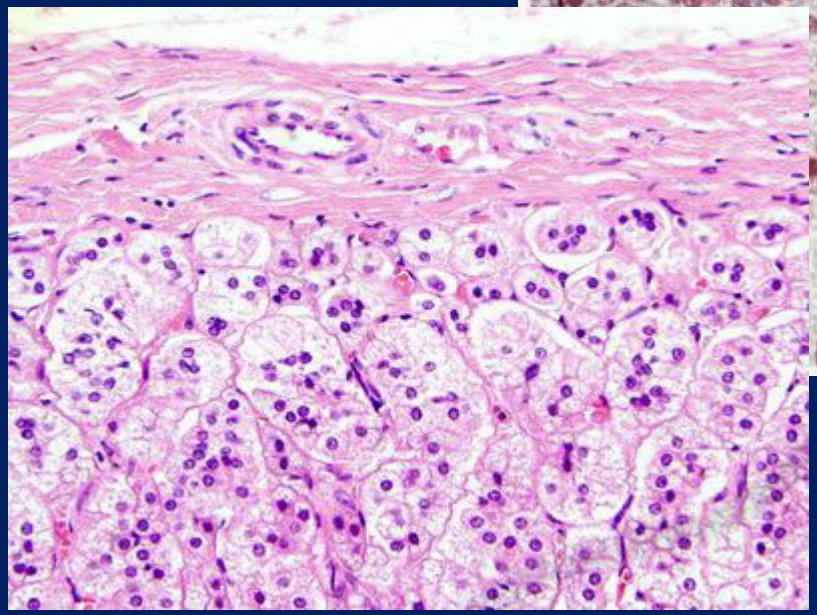
- Do not store secretory products in granules
- Synthesize steroids, and diffuse freely from plasma membrane on demand
- Typical steroid secreting cells-
  - Acidophilic
  - Central nucleus
  - Cytoplasm rich in lipid droplets
  - Exceptionally rich SER(for steroid synthesis)
  - Elongated spherical mitochondria- tubular cristae (not shelflike) and there is a close collaboration with SER

Zona glomerulosa

- Columnar or pyramidal cells
- Arranged in closely packed rounded /ovoid clusters
- Surrounded by capillaries
- Secretes mineralocorticoids

Aldosterone





Zona fasciculata

- Straight cell cords
- One or two cell thick
- Run at angles to the surface
- Fenestrated sinusoidal capillaries run in between them
- Cells – polyhedral
- Lipid droplets in the cytoplasm
- Secrete Glucocorticoids

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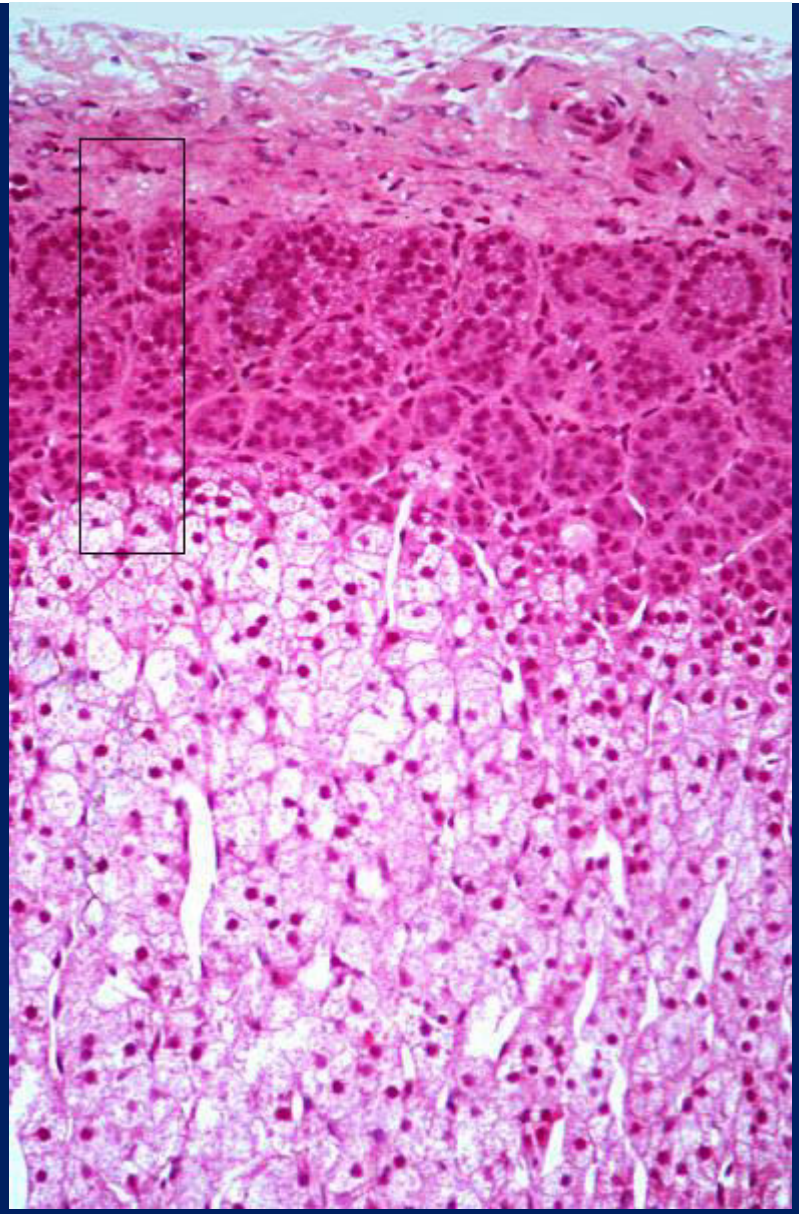
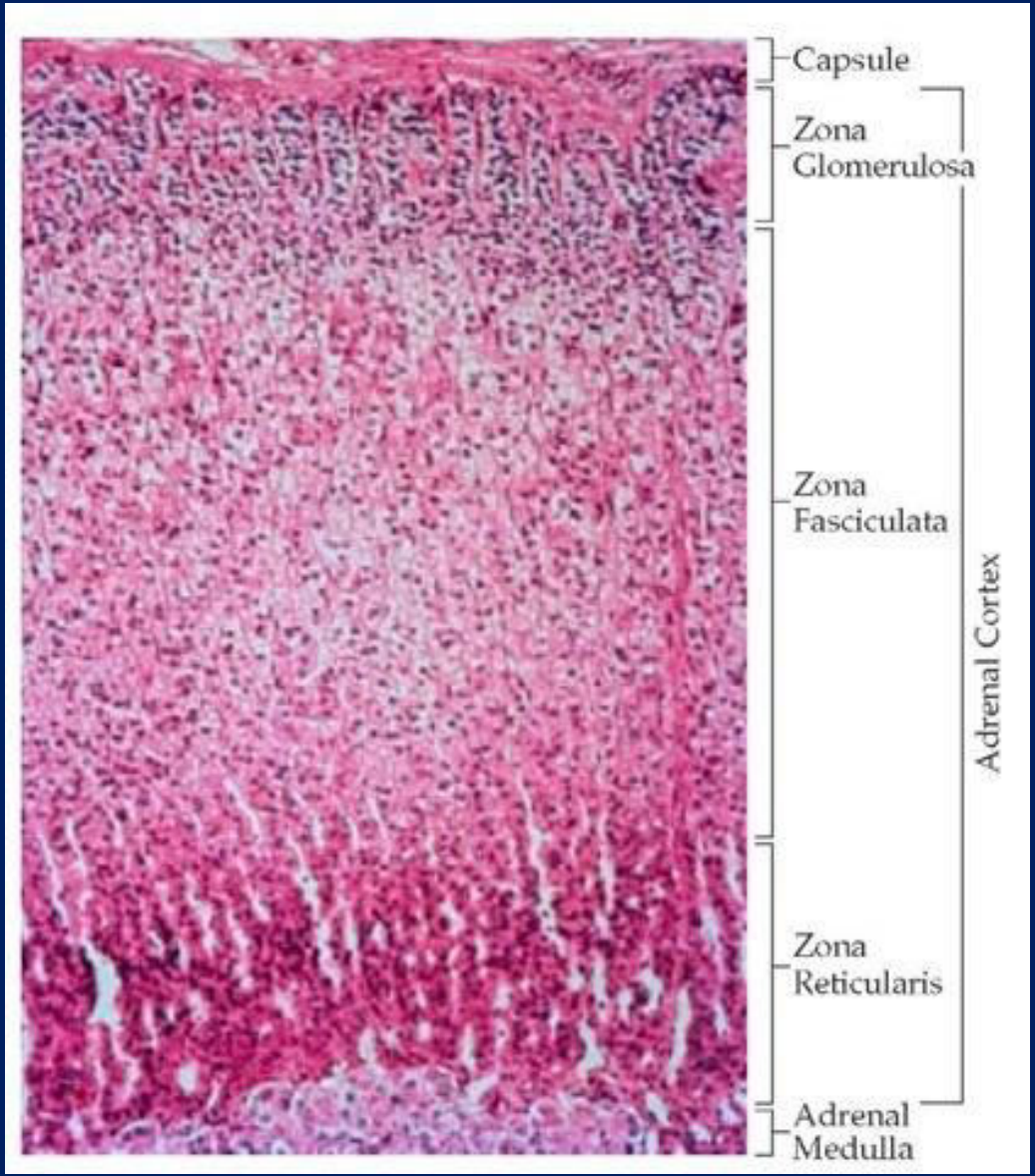
Cortisol



Zona reticularis

- Inner most
- Cells in irregular cords that form a net work
- Cells smaller than other two layers
- cells are interspersed with sinusoidal capillaries
- Usually more heavily stained than other zones (less fat)
- Secrete androgens

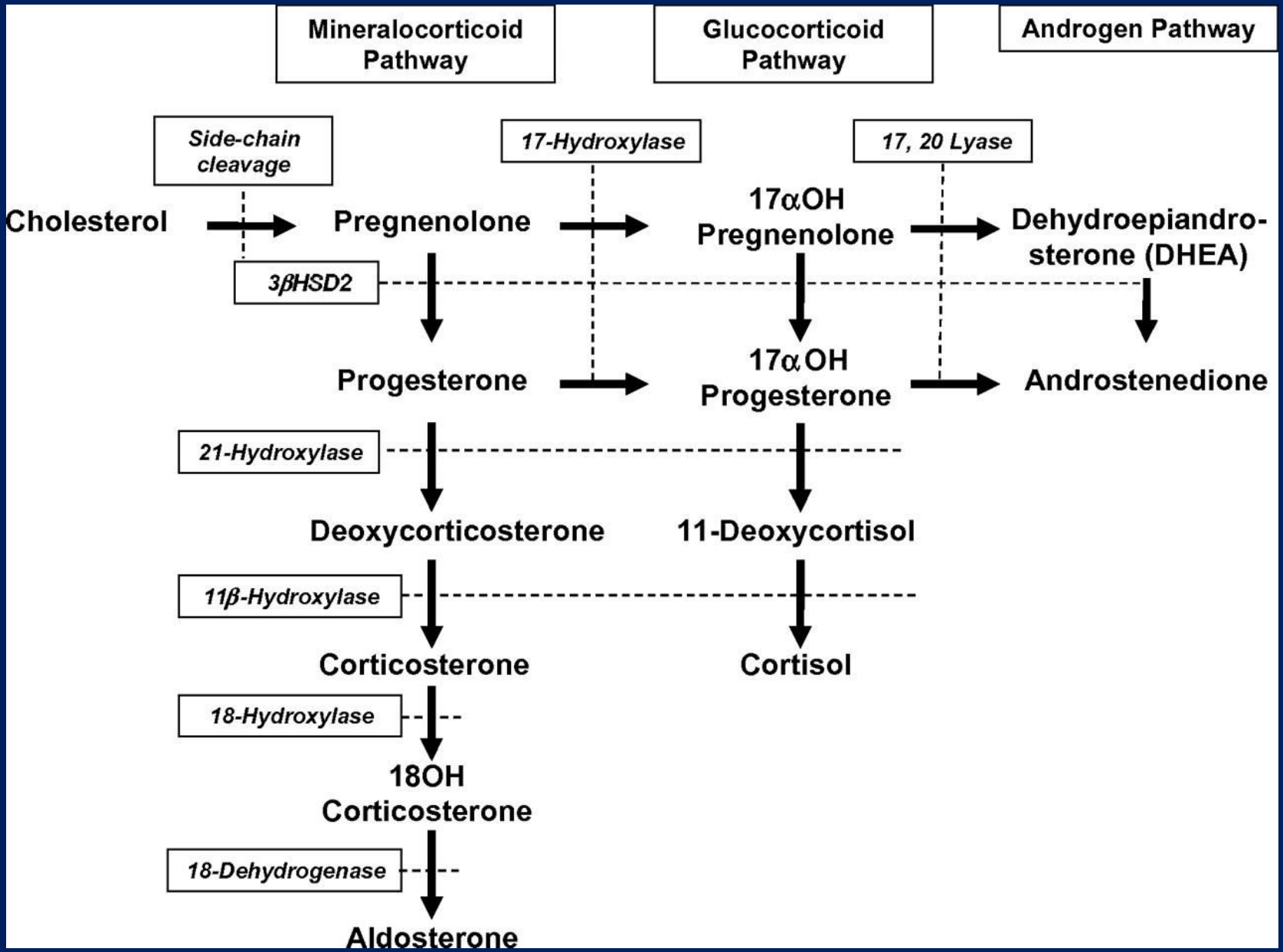


Clinical significance

- **Medical**
- Ambiguous genitalia with or without salt wasting in the newborn (CAH)

- *Cushing syndrome* -glucocorticoid excess
- *Addison Disease* - deficiency of aldosterone
- *Conn syndrome* – Mineralocorticoid/aldosterone excess

Congenital adrenal hyperplasia

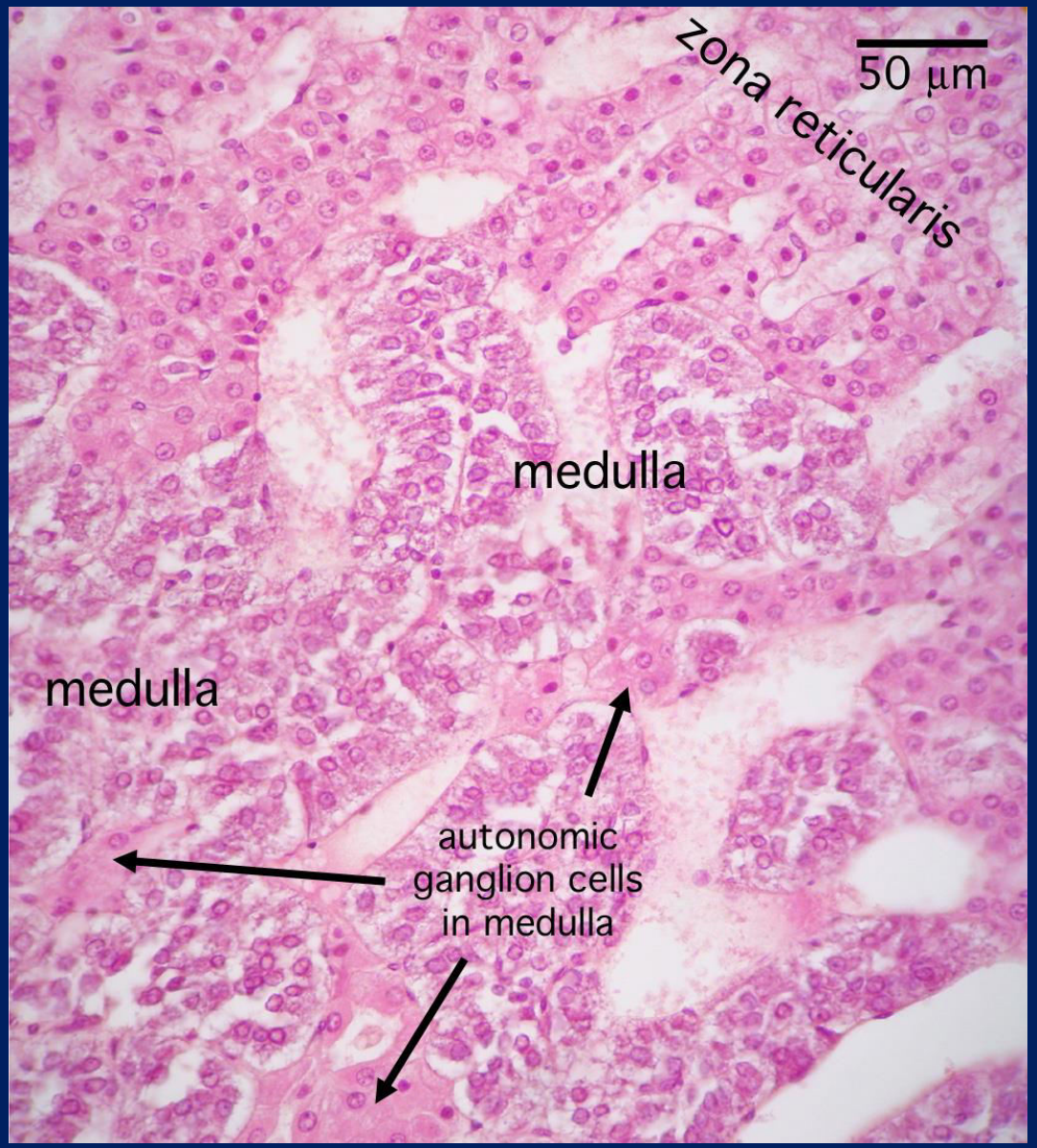


Clinical significance

- **Surgical**
- Tumors
  - Palpable abdominal mass
  - Adrenal medullary tumors: pheochromocytoma and neuroblastoma
  - Tumors > 10cm- laparotomy
  - Tumors < 10cm- laparoscopy

Adrenal medulla

- Polyhedral parenchymal cells- **chromaffin cells**
- Arranged in cords or clumps
- Supported by a reticular fibre network
- Rich sinusoidal capillary supply
- Few parasympathetic ganglion cells
- Arise from neural crest cells- as do the post ganglionic neurons of sympathetic/parasympathetic ganglia

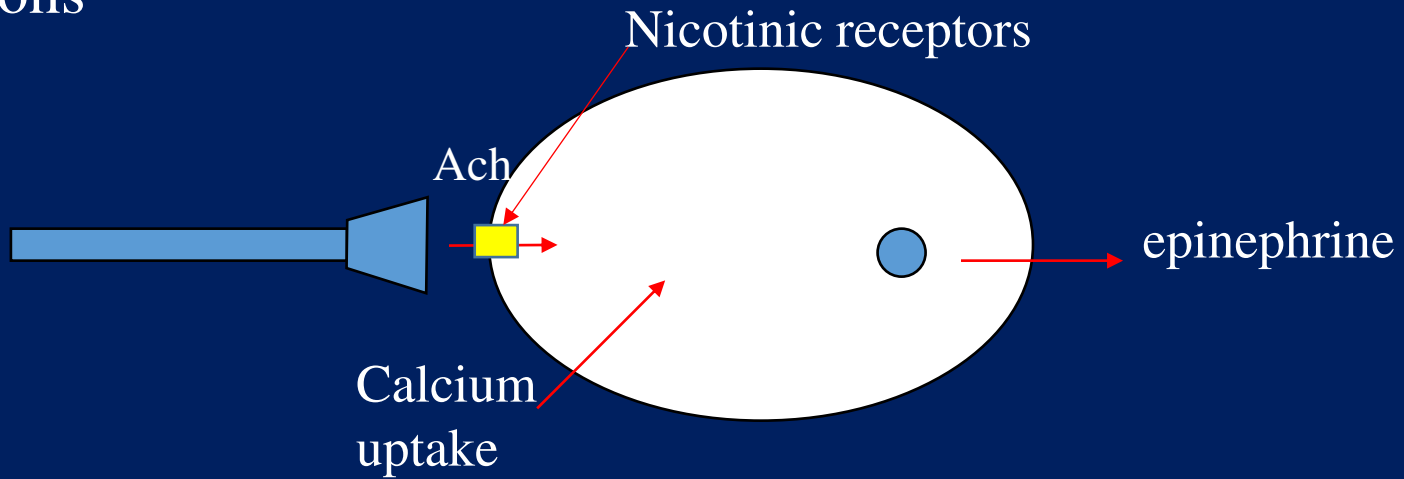


Adrenal medulla

- Cells regarded as modified sympathetic post ganglionic neurons (chromaffin cells/ Pheochromocytes)
- Cells have abundant membrane bound electron dense secretory granules (for storage and secretion of catecolamines)
- granules contain - Epinephrin -80%
  Norepinephrin
  ATP
  Protein- chromogranins
  Dopamine ß hydroxylase
- Under normal conditions - very small amount of hormones is released
- Under stressful condition- output is increased

Adrenal medulla

- Epinephrin and nor- epinephrin are secreted by two different cells types
  - **Epinephrin secretory granules – small less electron dense**
  - **Norepinephrin secretory granules –large more electron dense**
- Innervated by cholinergic endings of preganglionic sympathetic neurons



Adrenal medulla

- Cortex- cells do not store hormones
- Medulla store their hormones
- Hormones are secreted in large quantities in response to intense emotional stress
- **Typical responses ("fight or flight"):**
  - **iris dilatation**
  - **increased heart rate**
  - **bronchodilatation**
  - **intestinal relaxation**
  - **glycogenolysis**
  - **lypolysis**

Pheochromocytoma is a tumor of adrenal medulla