



Endocrine Block

Embryology Team



Lecture 2: Anatomy & Embryology of Adrenal Glands

Lama AlShwairikh
Norah AlRefayi
Sarah AlKhelb

Nawaf Modahi
Abdulrahman Ahmed Al-Kadhaib
Khalid Al-Own
Abdulrahman Al-khelaif

Done By: Sarah AlKhelb & Abdulrahman Ahmed Al-Kadhaib

Revised By: Nawaf Modahi & Lama AlShwairikh

Objectives :

At the end of the lecture, the students should be able to describe the:

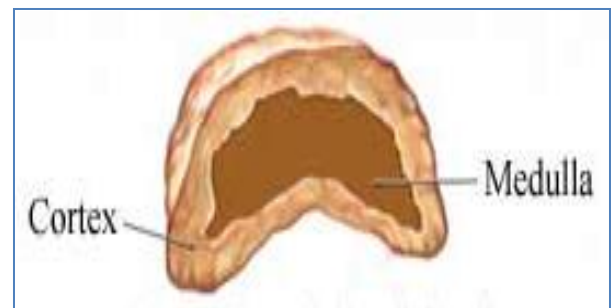
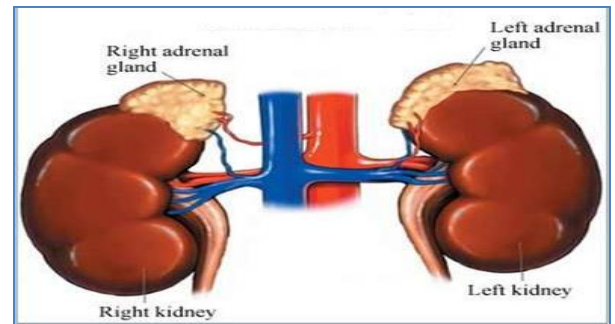
- Location, shape and relations of the right and left adrenal glands.
- Blood supply, lymphatic drainage and nerve supply of right and left adrenal glands
- Parts of adrenal glands and function of each part.
- Development of adrenal gland and common anomalies.

Red = important

Green= team notes

Suprarenal Glands (Adrenal Glands)

- The two suprarenal glands are yellowish retroperitoneal organs that lie on the upper poles of the kidneys, just above the **level of T12**
- They are surrounded by renal fascia (**but are separated from the kidneys by the perirenal fat**).
- Each gland has an outer **cortex** and an inner **medulla**.

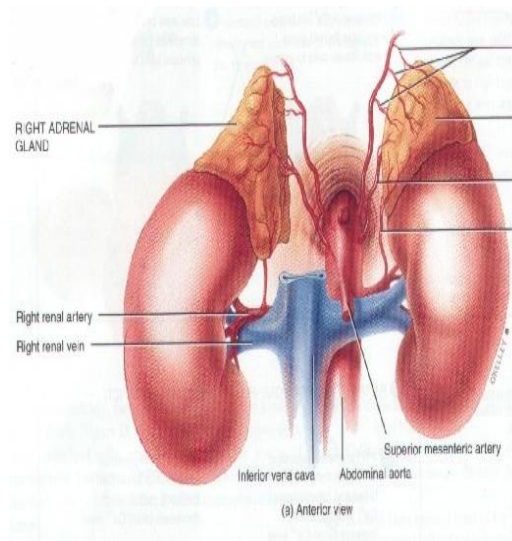


The **right gland** is **pyramid shaped** and caps the **upper pole** of the right kidney.

Relations:

Anterior: right lobe of the liver and inferior vena cava.

Posterior: diaphragm.



The **left gland** is **crenscent in shape** and extends along the **medial border** of the left kidney from the upper pole **to the hilus**.

Relations:

Anterior: pancreas, lesser sac, and stomach

Posterior: diaphragm.

Crescent shape = moon shape

Both right and left adrenal glands have the same posterior relations.

Arteries: The arteries supplying each gland are **three** in number:

Superior, middle, and inferior suprarenal arteries. Arising from branches of **three** main arteries:

Inferior phrenic

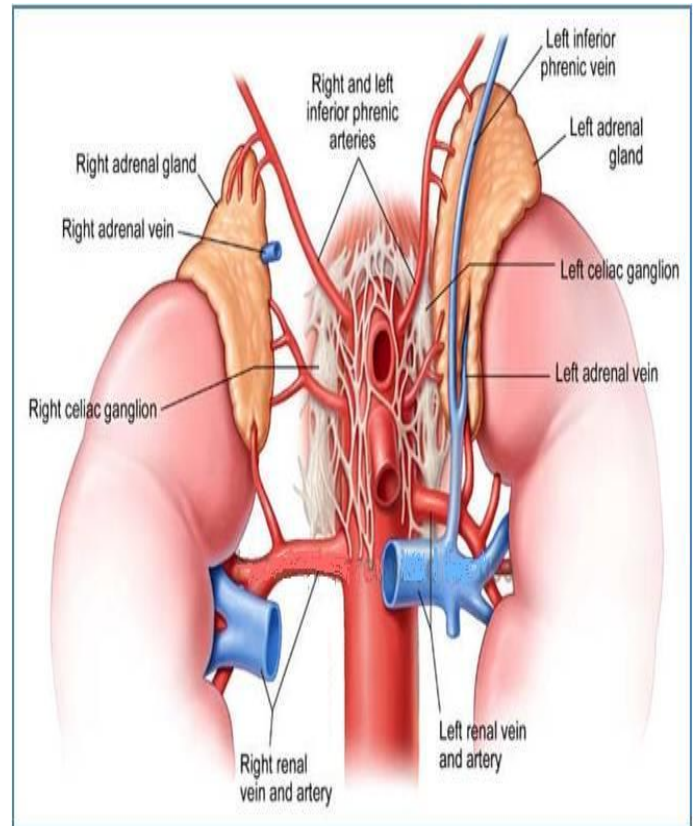
Aorta (Abdominal Aorta)

Renal artery.

Veins: A **single** vein emerges from the hilum of each gland and drains into the **Inferior vena cava** on the right & **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. Most of the nerves end in the medulla of the gland.



Functions:

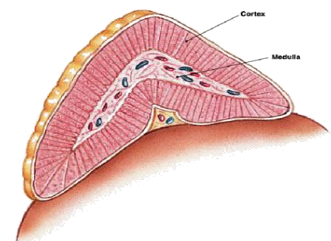
1) The **cortex** of the suprarenal glands secretes hormones that include:

***Mineral corticoids**, which are concerned with the control of fluid and electrolyte balance

***Glucocorticoids**, which are concerned with the control of the metabolism of carbohydrates, fats, and proteins

*Small amounts of **sex hormones**, which probably play a role in the prepubertal development of the sex organs.

2) The **medulla** of the suprarenal glands secretes the catecholamines:
epinephrine and norepinephrine

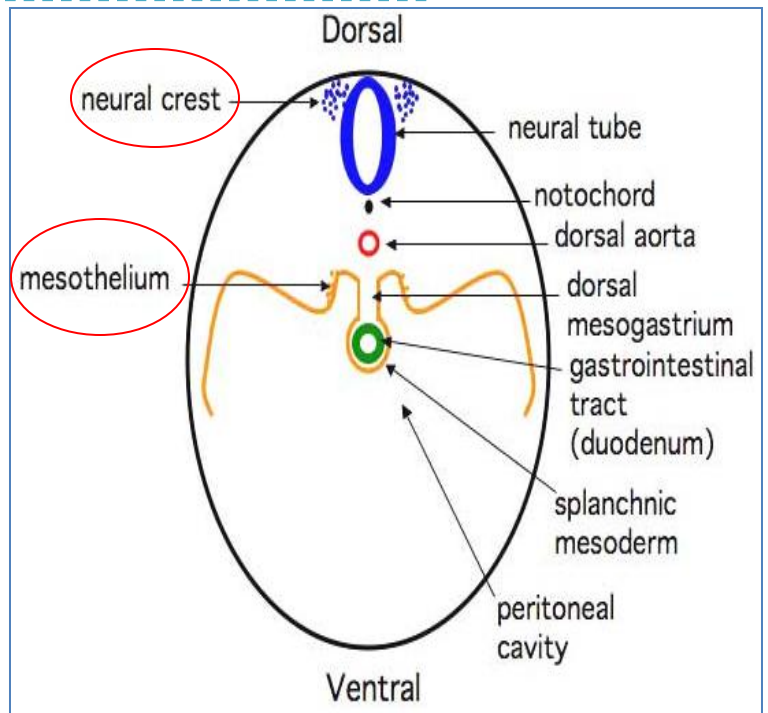


Development of the Adrenal Glands

The **two parts** of the adrenal gland i.e. the cortex and the medulla **develop from different origins**.

Cortex develops from the **coelomic epithelium (mesothelium)** derived from **mesoderm**

Medulla develops from the **neural crest cells**



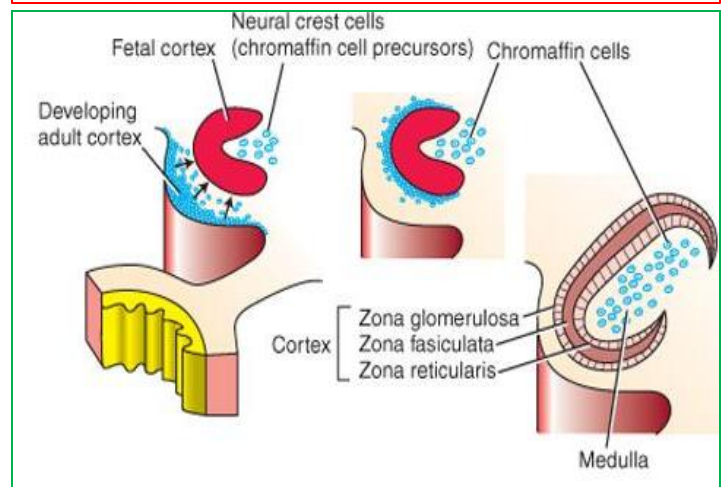
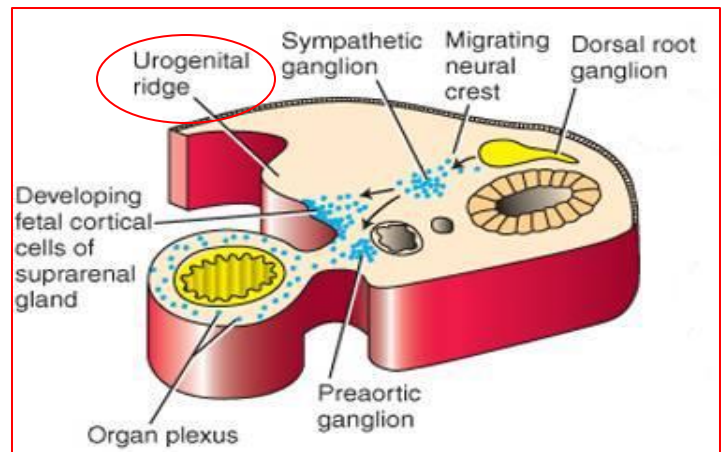
- Celom is the large cavity around the gut , and the coelomic epithelium is the epithelium lined this cavity .

The cortex

During **6th week** of development, the **coelomic epithelium** medial to the developing **gonadal ridge (urogenital ridge)** proliferates.

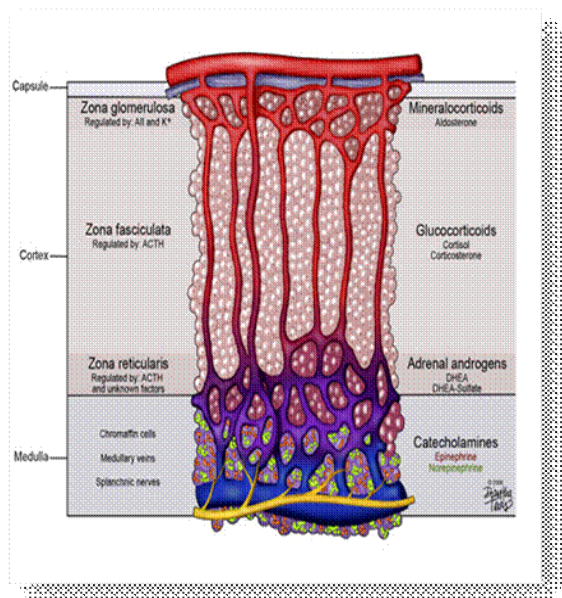
The newly formed cells get separated from the surface epithelium enter the **underlying mesoderm**, and form the **fetal cortex**

A second wave of delaminating cells migrates and forms a thinner **definitive (permanent) cortex** surrounding the fetal cortex



* Ultrastructurally, cells of both fetal and definitive cortical layers exhibit cytologic characteristics of steroid-producing cells. (the same structure and function)

- Differentiation of the characteristic suprarenal cortical zones (*glomerulosa, fasciculata & reticularis*) begins during the late fetal period.
- **At birth Zona glomerulosa & zona fasciculata** are present, but the **zona reticularis** is not recognizable until the end of third year.



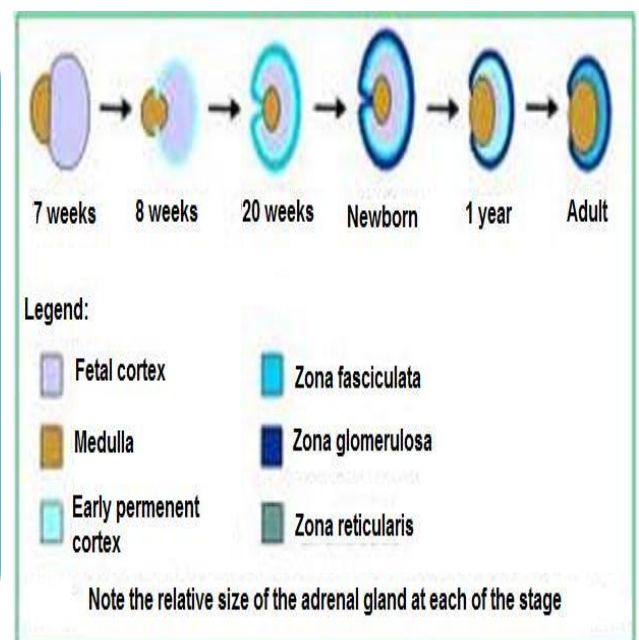
The medulla

- Formed from the **sympathochromaffin cells** of the **neural crest**.
- These cells invade the cortex on its medial side, occupy the central position and differentiate into the secretory cells.
- Preganglionic sympathetic nerve fibers grow into the medulla, release **Epinephrine** and **Norepinephrine** upon sympathetic stimulation, and influence the activity of the medullary cells.

The suprarenal gland of the fetus is 10-20 times larger than the adult glands relative to the body weight, and are large compared with the kidneys. **This is because of the extensive size of the fetal cortex. The medulla remains relatively small until after birth.**

The suprarenal glands rapidly become smaller during the **first 2-3 weeks after birth**, due to the rapid regression of the fetal cortex. Its involution is largely completed in the **first year** of life. (like the thymus gland)

During the process of involution, the cortex is **friable and susceptible to trauma** at birth leading to severe hemorrhage.



Congenital Anomalies

Congenital adrenal hyperplasia (CAH):

An abnormal **increase** in the cortical cells results in excessive **androgen** production during the fetal period.

In females: it may lead to **musculization** (**male like**)of external genitalia and enlargement of clitoris.

In males: it may remain **undetected** in early infancy.

Later in childhood: in both sexes, androgen excess may lead **to rapid growth and accelerated skeletal maturation.**

Time table for development of the adrenal gland

Time	Event
6 th week	Fetal and definitive cortex development
At birth	Zona glomerulosa & Zona Fasciculate appearance
first 2-3 weeks after birth	rapid regression of the fetal cortex
first year of life	Complete involution of adrenal gland
Third year.	Zona Reticularis appearance

Summary: Suprarenal Glands (Adrenal Glands)

Info	<ul style="list-style-type: none"> *Yellowish retroperitoneal organs *Lie on the upper poles of the kidneys, just above the level of T12 *Surrounded by renal fascia *Separated from the kidneys by the perirenal fat *Each gland has an outer cortex and an inner medulla 	
Shape	Right Gland	Left Gland
	<ul style="list-style-type: none"> *Pyramid shaped *Caps the upper pole of the right kidney 	<ul style="list-style-type: none"> *Crescent in shape *Extends along the medial border of the left kidney from the upper pole to the hilus
Anterior Relations	<ul style="list-style-type: none"> *Right lobe of the liver *Inferior vena cava 	<ul style="list-style-type: none"> *Pancreas *Lesser sac *Stomach
Posterior Relations	Diaphragm	
Arteries	Branches from three main arteries: <ul style="list-style-type: none"> *Inferior phrenic *Abdominal Aorta *Renal artery 	
Veins	<ul style="list-style-type: none"> *A single vein emerges from the hilum *Drains into the Inferior vena cava 	<ul style="list-style-type: none"> *A single vein emerges from the hilum *Drains into the renal vein
Lymph Drainage	Lateral aortic nodes	
Nerve Supply	<ul style="list-style-type: none"> *Preganglionic sympathetic fibers derived from the splanchnic nerves. *Most of the nerves end in the medulla of the gland 	
Secreted Hormones	The cortex	The medulla
	<ul style="list-style-type: none"> *Mineral corticoids: control of fluid and electrolyte balance *Glucocorticoids: control of the metabolism of carbohydrates, fats, and proteins *Small amounts of sex hormones: Play a role in the prepubertal development of the sex organs. 	<ul style="list-style-type: none"> Catecholamines: *Epinephrine *Norepinephrine

Dr. Essam's Summary

Anatomy:

- The suprarenal glands are **retroperitoneal** organs that lie on the upper poles of the kidneys, just above the level of the last thoracic vertebra (T12).
- Anterior relations of the right suprarenal gland are: right lobe of the liver and inferior vena cava.
- Anterior relations of the left suprarenal gland are: pancreas, lesser sac, and stomach.
- Posterior relation of both the right and left suprarenal glands is: diaphragm.
- The arteries supplying the suprarenal glands are:
 - 1- Superior suprarenal artery which arises from inferior phrenic artery.
 - 2- Middle suprarenal artery which arises from abdominal aorta.
 - 3- Inferior suprarenal arteries which arises from renal artery.
- The right suprarenal vein drains into the inferior vena cava
- The left suprarenal vein drains into the left renal vein.

Embryology:

- The **cortex** of the adrenal gland is **mesodermal** in origin (from mesenchymal cells).
 - The **medulla** of the adrenal gland is **ectodermal** in origin (from neural crest cells).
 - After development of the fetal cortex of the adrenal glands, a second wave is formed (permanent cortex) and it surrounds the fetal cortex and medulla of the adrenal glands.
 - Cortical zones of the adrenal glands are:
 - 1- Zona glomerulosa
 - 2- Zona fasciculata
 - 3- Zona reticularis (present at the end of the third year).
- } present at birth
- Regression of the fetal cortex begins during the first 2-3 week after birth and it is completed in the first year of life

Questions

1- The location of suprarenal glands is:

- A. Above the 9th thoracic vertebra (T9)
- B. Above the 10th thoracic vertebra (T10)
- C. Above the 11th thoracic vertebra (T11)
- D. Above the 12th thoracic vertebra (T12)

2- Which one of the following structures is posteriorly related to the right and left suprarenal glands?

- A. Right lobe of the liver
- B. Diaphragm
- C. Inferior Vena Cava
- D. Lesser Sac

3- The middle suprarenal artery arises from:

- A. Renal artery
- B. Superior phrenic artery
- C. Abdominal aorta
- D. Inferior phrenic artery

4- The origin of the adrenal cortex is :

- A. Endoderm
- B. Ectoderm
- C. Mesoderm
- D. Neural crest cells

5- The medulla of adrenal glands develops from:

- A. Mesoderm
- B. Neural crest cells
- C. Endoderm
- D. Mesenchymal cells

6- Which one of the following adrenal zones is present at the third year ?

- A. Zona glomerulosa
- B. Zona fasciculata
- C. Zona reticularis

Answers: 1- D 2- B 3- C 4- C 5- B 6- C