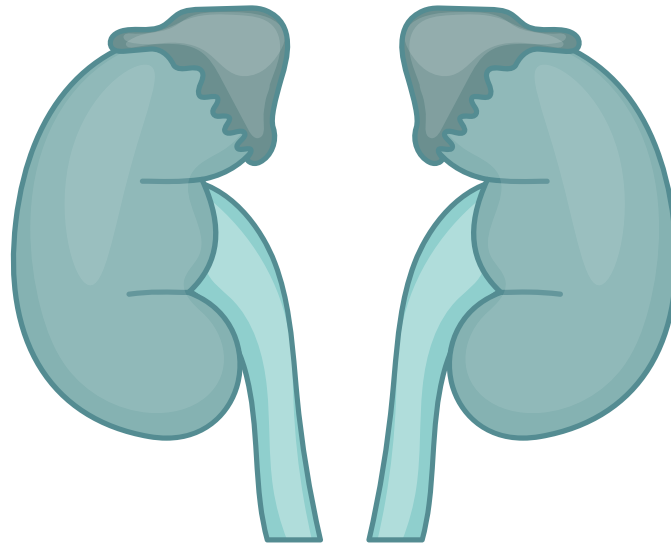


رَضِيَانٌ كَرِيمٌ



Anatomy & Embryology of adrenal gland

Endocrine block

Color Index

Main Text

Male's Slides

Female's Slides

Important

Doctor's Notes

Extra Info

[The Editing File](#)



Objectives



Describe the location, shape and relations of the right and left adrenal glands.



Describe the Blood supply, lymphatic drainage and nerve supply of right and left adrenal glands.



Identify the parts of adrenal glands and function of each part.



Describe the development of adrenal gland and common anomalies.



يهنئكم فريق عمل الأناتومي بقرب حلول شهر رمضان المبارك،
جعلنا الله وإياكم من صوامه وقوامه.
ونذكركم؛ بالآ تلهيكم دراستكم عن الطاعات.

This lecture was presented by :

Dr. Zahid Kaimkhani

Dr. Tahani Al Matrafi



You can find Atlas by [Clicking HERE!](#)

Adrenal (Suprarenal) gland

Overview

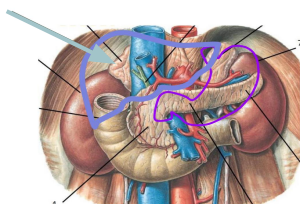
- ➔ The suprarenal (adrenal) gland is a component of the **hypothalamic-pituitary-suprarenal axis** that is responsible for coordinating **stress response** and **metabolism**.
- ➔ Suprarenal gland consist of the **cortex** and **medulla**, and represent two developmentally and functionally independent endocrine glands within the same anatomical structure.
- ➔ They are **yellowish retroperitoneal** organs that cap the upper poles of each kidney and lie against the **crura of the diaphragm**.
- ➔ Each gland weighs **3-4 gm**.
- ➔ At the level of the last thoracic vertebra (**T12**).
- ➔ They are surrounded by **renal fascia** (but are separated from the kidneys by the **perirenal fat**).
- ➔ Each gland has an outer yellow **cortex** and an inner dark brown **medulla**.

Right Adrenal glands

It's **pyramidal** in shape.
Caps the upper pole of the kidney.

Relations

Anterior	<ul style="list-style-type: none"> • Right lobe of the liver • Inferior vena cava
Posterior	<ul style="list-style-type: none"> • Diaphragm
Medial	<ul style="list-style-type: none"> • Celiac plexus and ganglia

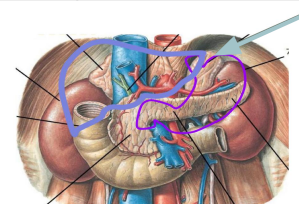


Left Adrenal glands

It's **crescentic** in shape.
Extends along the medial border of the left kidney from the upper pole to the hilus.

Relations

Anterior	<ul style="list-style-type: none"> • Pancreas • Lesser sac • Stomach
Posterior	<ul style="list-style-type: none"> • Diaphragm (left crus)
Medial	<ul style="list-style-type: none"> • Celiac plexus and ganglia

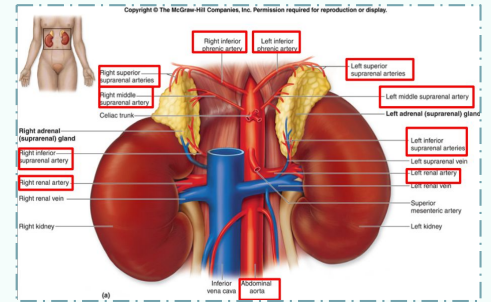


Supply of the adrenal gland

Arterial Supply

Three arteries supplying each gland:

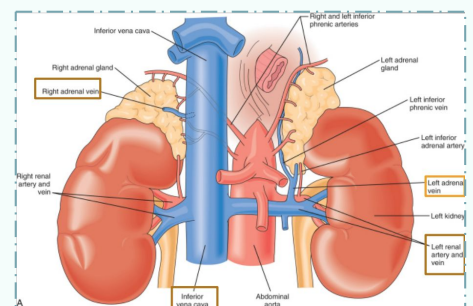
- ➔ Superior Suprarenal Arises from → **Inferior phrenic artery**
- ➔ Middle Suprarenal Arises from → **Abdominal aorta**
- ➔ Inferior Suprarenal Arises from → **Renal artery**



Venous Drainage

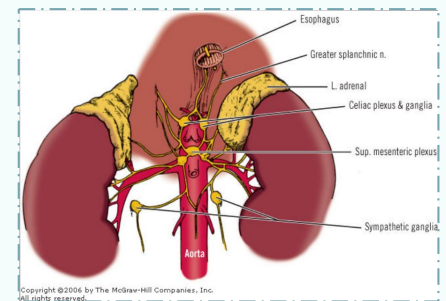
Unlike arterial supply, A single vein emerges from the hilum of each gland draining into:

- ➔ Right Adrenal vein Drains into → **Inferior vena cava**
- ➔ Left Adrenal vein Drains into → **Left renal vein**



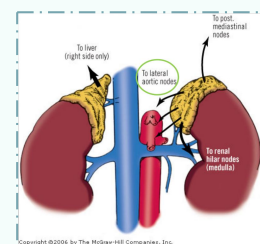
Nerve Supply

Preganglionic sympathetic fibers derived from the splanchnic nerves supply the gland, especially the **greater splanchnic** pass via the **coeliac plexus** to end by synapsing with cells in the **suprarenal medulla**. Most of the nerves end in the **medulla** of the gland.



Lymphatic drainage

The lymph drains into the **lateral aortic** lymph nodes.



Functions of the adrenal gland

Function of Adrenal Gland

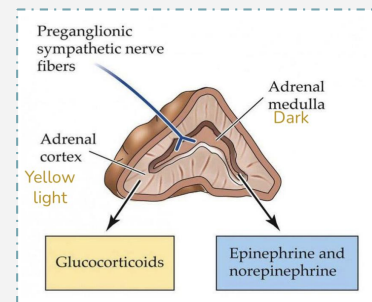
Cortex

Cortex is essential to life and produce three types of steroid hormones (secrete hormones) that include:

- ➔ **1-Mineralocorticoids**, which are concerned with the control of **fluid and electrolyte balance**. *Zona glomerulosa*
- ➔ **2-Glucocorticoids**, which are concerned with the control of the **metabolism** of carbohydrates, fats, and proteins. *Zona fasciculata*
- ➔ **3-Small amounts of sex hormones**, which probably play a role in the **prepubertal development** of the sex organs. *Zona reticularis*

Medulla

Secretes the catecholamines: epinephrine and norepinephrine

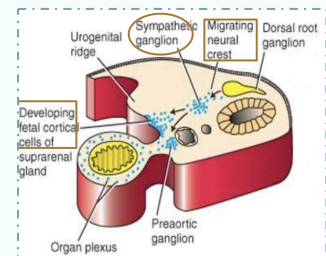


Development of adrenal gland

The two parts of the adrenal gland, i.e. the (cortex and the medulla) develop from two different origins:

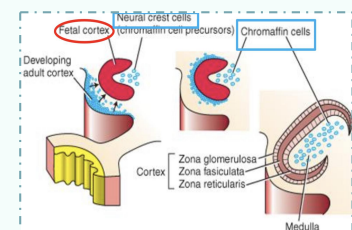
Cortex

- ▶ **Mesodermal** in origin.
- ▶ Develops from the celomic epithelium (mesothelium or mesenchymal cells) of the posterior abdominal wall.
- ▶ During the **6th week** of development (*fetal cortex*), by aggregation of the mesenchymal cells.
- ▶ **Begin to proliferate and penetrate the underlying mesenchyme.**
- ▶ Between the root of the **dorsal mesentery** and the developing gonads.
- ▶ Differentiate into large acidophilic organs, which form the **fetal cortex, primitive cortex.**



Medulla

- ▶ **Ectodermal** in origin.
- ▶ Develops from the **neural crest cells**.
- ▶ It forms a **mass medial** to the **fetal cortex**, which is derived from the adjacent **sympathetic ganglion**; from neural crest cells.
- ▶ **As they are surrounded by the cortex, the cells differentiate into the secretory cells of the suprarenal medulla.**

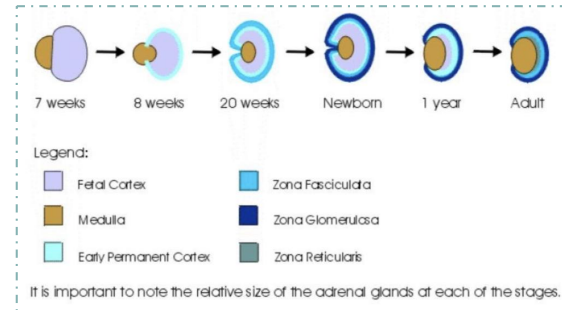


Development of adrenal gland

Permanent cortex

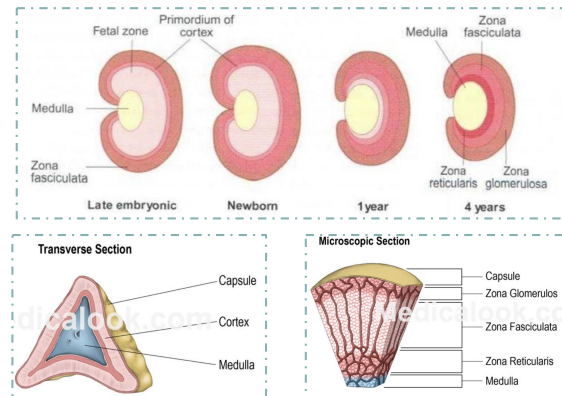
- ▶ A **second wave** of mesenchymal cells arise from the mesothelium, **surrounds the primitive cortex/ enclose the fetal cortex**.
- ▶ forms a thinner definitive (permanent) cortex.

medulla will never change once it invade the cortex, but Fetal cortex will be covered by new layer of mesenchymal cells which will form permanent cortex, the primary or fetal cortex gradually degenerate.



Differentiation

- ▶ Differentiation of the characteristic suprarenal cortical zone begins during the **late fetal period**.
- ▶ **Zona glomerulosa & Zona fasciculata** are present at birth, but, **Zona reticularis** (deeper layer) is not recognizable **until the end of third year**. (so, its full development at the end of the 3rd year).



suprarenal gland

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.

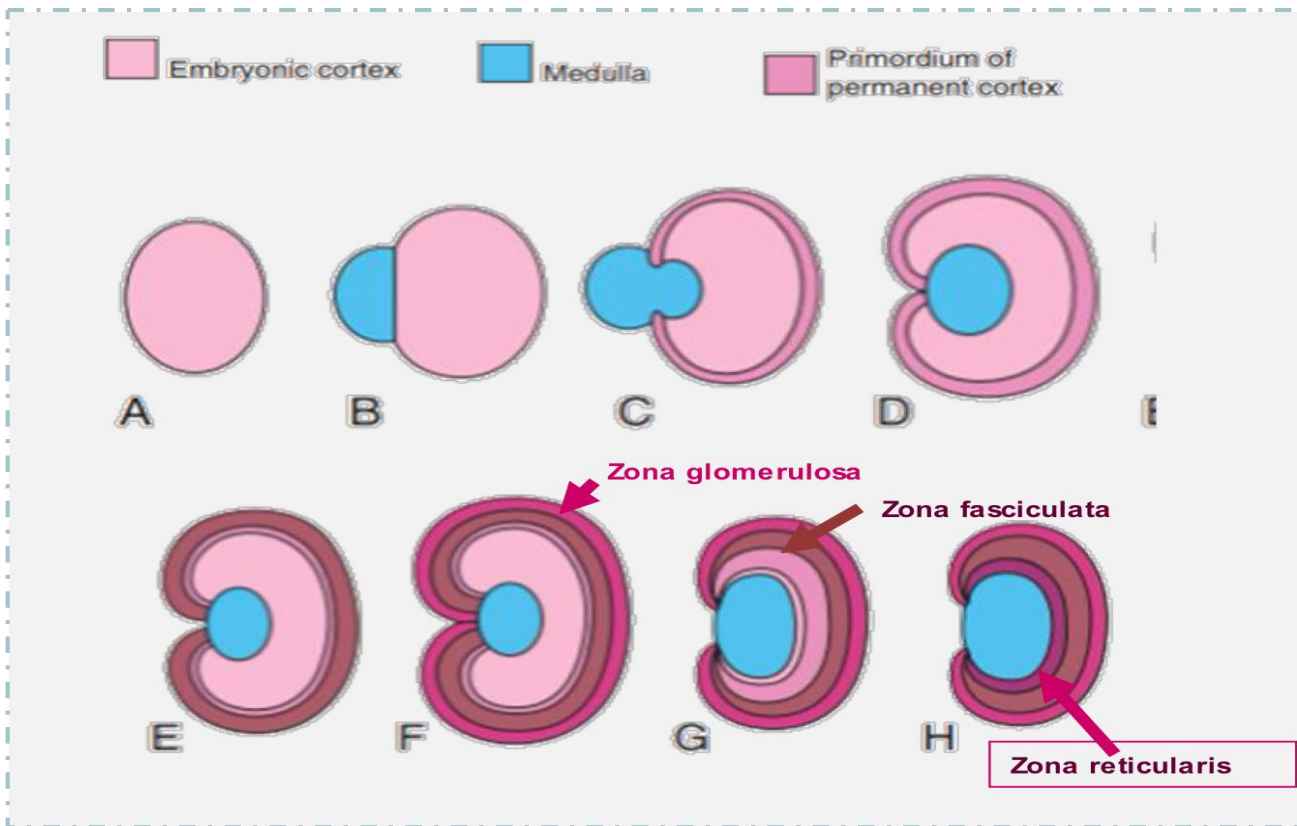
The suprarenal glands due to the rapid regression of the fetal cortex, become smaller ; it loses about **1/3** of its weight, during the **first 2-3 weeks** after birth.

They regain their original weight about the **end of the second year**.

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

The **involution process** is largely completed in the **first year of life**.

Development of adrenal gland



(A): At 6 weeks, showing the mesodermal primordium of the embryonic 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 cortex has almost disappeared.

(H) At 4 years, showing the adult pattern of cortical zones.

(I) Note that the cortex has disappeared and the gland is much smaller than it was at birth (F).

Development of adrenal gland

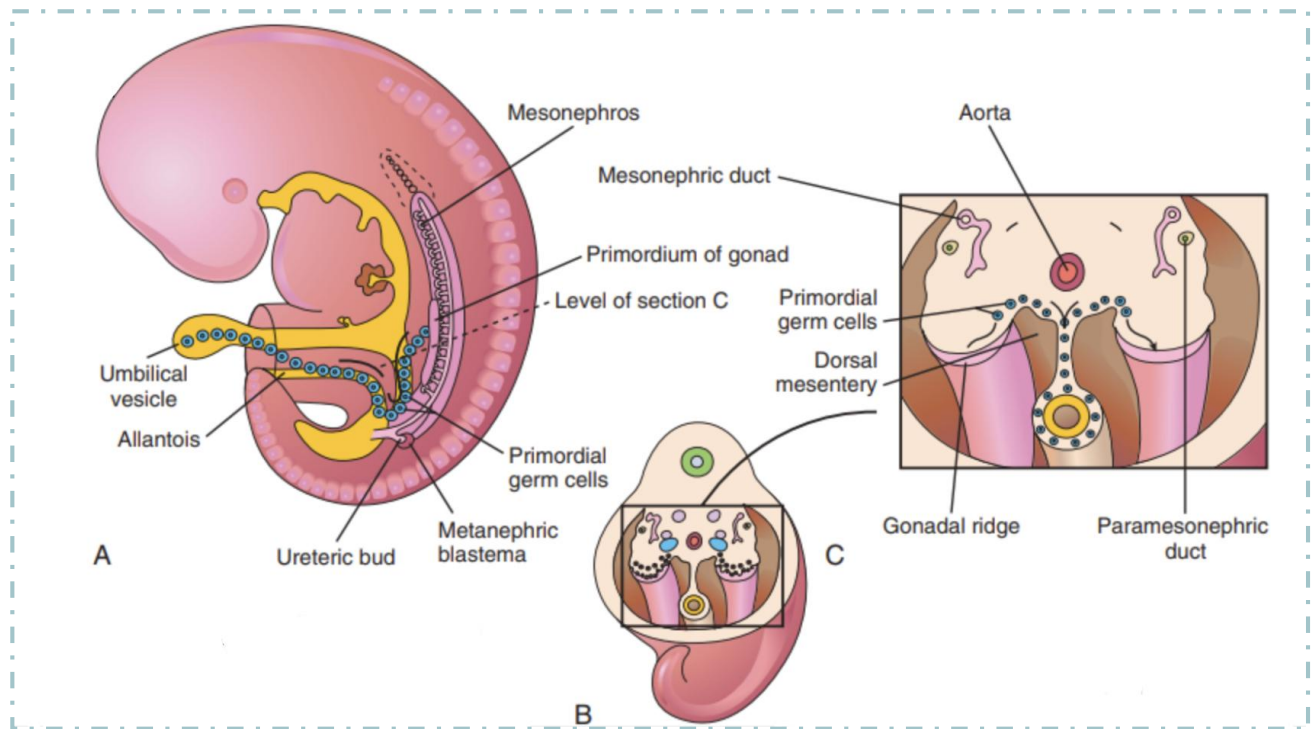


Fig. A, 5-week embryo, note the migration of primordial germ cells from the umbilical vesicle into the embryo.

Fig. B, 3D of the caudal region of a 5-week embryo showing the location and extent of the gonadal ridges.

Fig. C, TS showing the primordium of the suprarenal glands, the gonadal ridges, and the migration of primordial germ cells into the developing gonads.

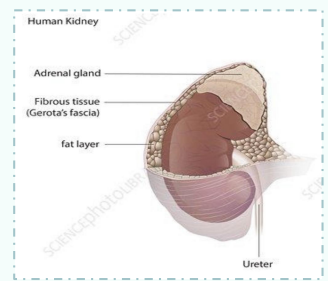
To Summarize [from slides](#)

- ▶ The cortex forms as a result of two waves of mesoderm proliferation.
 - a. The first wave of the coelomic mesothelial cells forms the fetal cortex.
 - b. The second wave of cells surrounds the fetal cortex and forms the adult cortex.
- ▶ The medulla forms from neural crest cells, which migrate to the fetal cortex and differentiate into chromaffin cells.

Clinical notes

Clinical note

- ▶ The suprarenal gland is enclosed within the renal fascia with the kidney but in a separate compartment that allow the two organs to be separated easily during surgery.
- ▶ In adrenalectomy, the veins are ligated before the arteries.
- ▶ The glands must be handled as little as possible before venous ligation.
- ▶ The stubby right suprarenal vein, coming directly from the inferior vena cava, presents the most dangerous feature in performing an adrenalectomy.



Cushing's syndrome

1

Suprarenal cortical hyperplasia, manifested by:
→ moon shaped face, truncal obesity, hirsutism, hypertension

Addison's Disease

2

Adrenocortical insufficiency, characterized by:
→ increase pigmentation, muscular weakness, weight loss, hypotension.

Pheochromocytoma

3

A tumor of the medulla, produces paroxysm and sustain hypertension. The signs and symptoms are produced by large amount of catecholamine.

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 masculinization, and enlargement of clitoris.

In males, have normal external genitalia and it may remain undetected in early infancy.

4

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

Summary of Adrenal gland

Structure	<ul style="list-style-type: none"> -They are yellowish retroperitoneal organs located at the upper poles of each kidney at the level of T12. -They are surrounded by renal fascia with kidney and separated from the kidney by perirenal fat. Structure -Each gland is composed of an outer yellow cortex and an inner dark brown medulla. -The suprarenal gland is enclosed within the renal fascia with the kidney but in a separate compartment that allow the two organs to be separated easily during surgery. 			
Function	<ul style="list-style-type: none"> -It is a component of the hypothalamic-pituitary-suprarenal axis that is responsible for coordinating stress response and metabolism. -The cortex secretes hormones that include: Function <ul style="list-style-type: none"> → mineralocorticoids: concerned in fluid and electrolyte balance. → glucocorticoids: concerned in metabolism of carbohydrates, fats and proteins. → sex hormones: Small amounts, play a role in the prepubertal development of the sex organs. -The medulla secretes the catecholamines: epinephrine and norepinephrine. 			
Supply	Arterial supply	Venous drainage	Nerve supply	Lymph drainage
	<ul style="list-style-type: none"> -Superior suprarenal A Origin: Inferior phrenic artery -Middle suprarenal A Origin: Abdominal aorta -Inferior suprarenal A Origin : Renal artery 	<ul style="list-style-type: none"> -Inferior Vena Cava (on right side) -Left Renal Vein (on left side) 	<ul style="list-style-type: none"> Preganglionic sympathetic fibers Derivatives of the Splanchnic nerves to supply the glands 	Drains Into: Lateral Aortic Lymph nodes
Right Adrenal gland			Left Adrenal gland	
<ul style="list-style-type: none"> -Shape: Pyramidal or triangular -Location: caps the upper pole of the right kidney -Relations: Anterior → right lobe of the liver and IVC Posterior → diaphragm Medial → celiac plexus and ganglia 			<ul style="list-style-type: none"> -Shape: crescentic or semilunar -Location: Extends along the medial border of the left kidney from the upper pole to the hilum -Relations: Anterior → pancreas, stomach and lesser sac Posterior → diaphragm Medial → celiac plexus and ganglia 	

Origin of adrenal gland

(Start to develop at the **6th week** & rapidly become **smaller** during the **first 2-3 weeks after birth**)

Adrenal cortex -Is mesodermal in origin -Develops from coelomic epithelium (mesothelium) from the posterior abdominal wall	Adrenal medulla -Is ectodermal in origin -Develops from the neural crest cells (chromaffin cells)		
Cortex (6 letters=6th week)	Medulla	Permanent cortex	Differentiation the suprarenal cortical zones complete their differentiation at the end of the third year Its involution is largely completed in the first year of life
<ul style="list-style-type: none"> -During 6th week of development, mesenchymal tissue aggregate forming the fetal cortex. -The fetal cortex is derived from mesothelium tissue between the developing gonads (gonadal ridge) and the dorsal mesentery. 	<ul style="list-style-type: none"> -Derived from the neural crest cells of the adjacent sympathetic ganglia. -it forms a mass medial to the fetal cortex. 	<ul style="list-style-type: none"> -A second wave of mesenchymal cells arise from the mesothelium -This encloses the fetal cortex forming a thinner permanent (definitive) cortex. 	<ul style="list-style-type: none"> -Zona glomerulosa (begin to appear during the late fetal period) -Zona fasciculata These 2 zones are presented at birth while a 3rd zone appears at the end of the third year called: -Zona reticularis (develops after birth) <small>Zona reticularis = the 3rd and last layer = end of the third year End = Last layer , Third year = 3rd layer</small>

Diseases and abnormalities

Cushing's syndrome	Addison's disease	Pheochromocytoma	Congenital adrenal hyperplasia (CAH)
<ul style="list-style-type: none"> -Suprarenal cortical hyperplasia. -manifested by; moon shaped face, truncal obesity, hirsutism, hypertension. 	<ul style="list-style-type: none"> -Adrenocortical insufficiency. -characterized by: increase pigmentation, muscular weakness, weight loss, hypotension. 	<ul style="list-style-type: none"> -A tumor of the medulla, produces paroxysm and sustain hypertension. -The signs and symptoms are produced by large amount of catecholamine. 	<ul style="list-style-type: none"> An abnormal increase in the cortical cells results in excessive androgen production; during the fetal period. -In females, it may lead to masculinization, 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

MCQs

Q1- Which of the following receives venous blood from the left suprarenal vein?

A- Inferior vena cava

B- Left inferior phrenic Vein

C- Left gonadal vein

D- Left renal vein

Q2- Superior suprarenal artery is a branch of?

A- Inferior phrenic A.

B- Abdominal Aorta

C- Renal A.

D- Superior phrenic A.

Q3- Which of the following structures lies anterior to the right adrenal gland?

A- Celiac plexus

B- Diaphragm

C- Lesser sac

D- Inferior vena cava

Q4- When does the adrenal cortex start to develop?

A- 4th week

B- 5th week

C- 6th week

D- 7th week

Q5- Which of the following ganglia gives rise to the Adrenal Medulla?

A- Spinal

B- Sympathetic

C- Parasympathetic

D- Enteric

Q6- Zona reticularis is formed at which of the following periods?

A- 1 year after birth

B- 3 years after birth

C- Late fetal period

D- Soon after birth

Q7- Which of the following is the origin of the Adrenal Cortex?

A- Neural crest

B- Mesoderm

C- Endoderm

D- Ectoderm

Answers: 1-D 2-A 3-D 4-C 5-B 6-B 7-B

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