

EMBRYOLOGY

LECTURE **DEVELOPMENT OF KIDNEYS & URETES**
#1





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OBJECTIVES

By the end of the lecture, you should be able to:

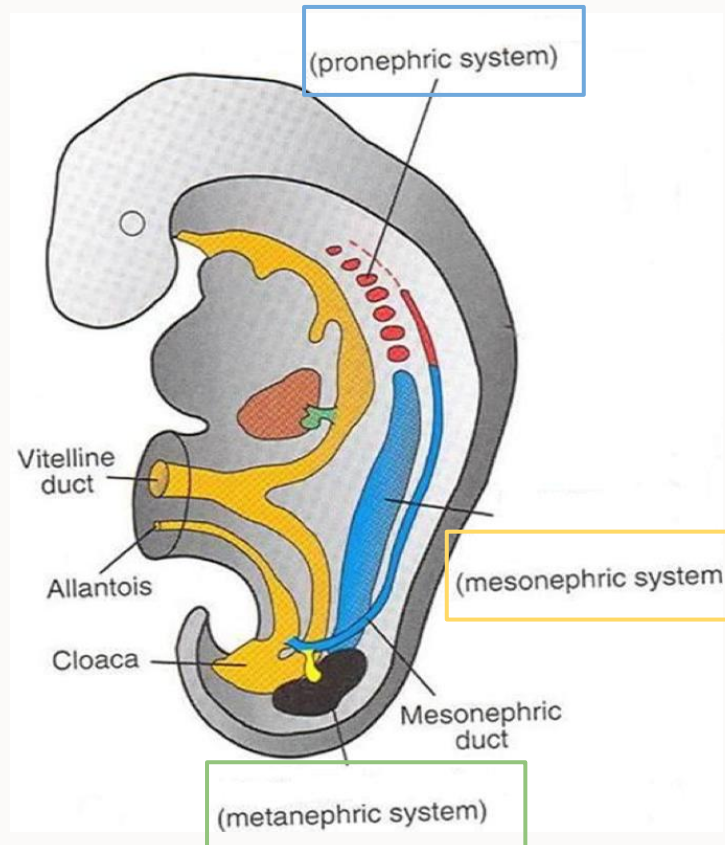
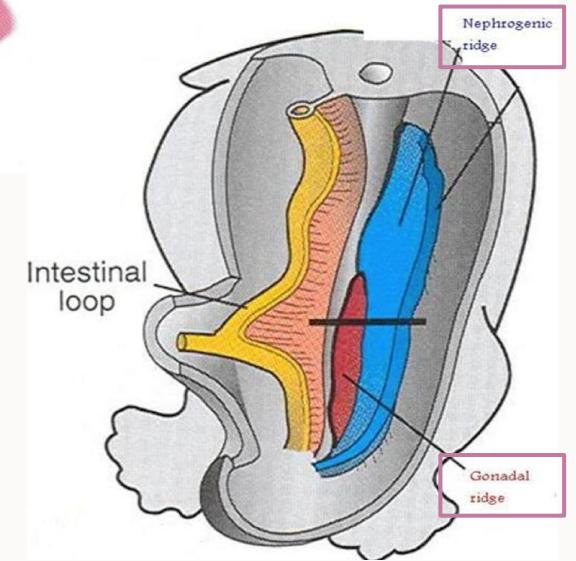
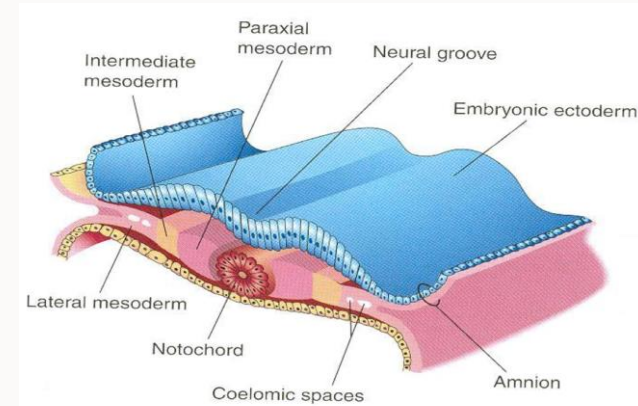
- At the end of the lecture, students should be able to:
- Identify the embryological origin of kidneys & ureters.
- Differentiate between the 3 systems of kidneys during development.
- Describe the development of collecting & excretory parts of permanent kidney.
- Describe the fetal kidney & identify the pre- and postnatal changes that occur in the kidney.
- Enumerate the most common anomalies of kidneys & ureters.

❖ EMBRYONIC ORIGIN OF THE KIDNEY

- **the kidney originates from (the Intermediate mesoderm).**
- **Intermediate mesoderm differentiate into:**
 1. **Nephrogenic ridge (cord):**
forms kidneys & ureters
 2. **Gonadal ridge** forms
gonads (testes or ovaries)

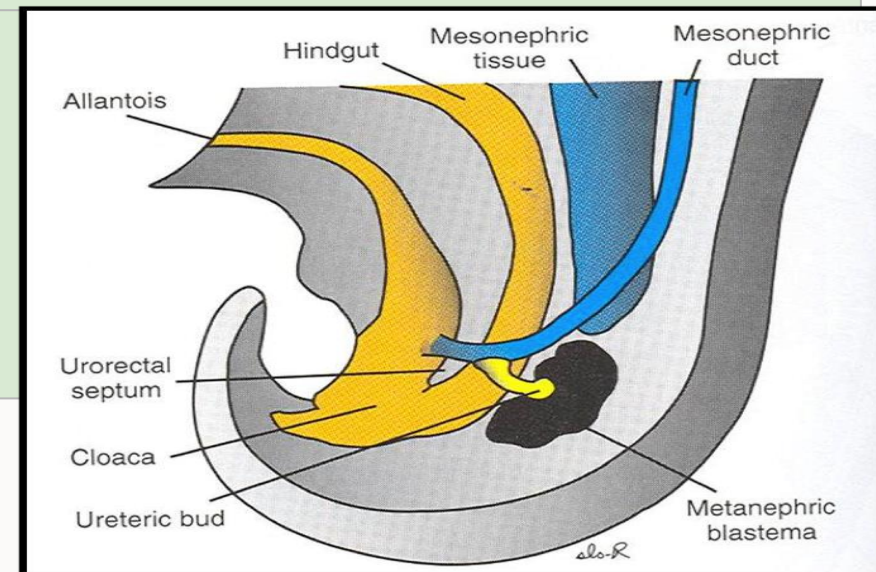
❖ DEVELOPMENT OF THE KIDNEY

THERE ARE **THREE** SYSTEMS OF KIDNEY THAT DEVELOPS....



❖ DEVELOPMENT OF THE KIDNEY

system	1. Pronephric system:	2. Mesonephric system:	3. Metanephric system:
Appears at	beginning of 4th week	end of 4th week	5th week BUT starts to function at 9th week
Location	cervical region	thoracic&abdominal regions	in pelvis
Formed of	tubules &a duct	tubules & a duct	METANEPHROS 2 origins: 1) Ureteric Bud (derived from mesonephric duct) → gives Collecting part of kidney 2) Metanephric Blastema (Mass): derived from nephrogenic cord → gives Excretory part of kidney
fate	<ul style="list-style-type: none"> Not function in human. Disappears. 	<ul style="list-style-type: none"> Function temporarily The duct: In male: forms genital duct In both sexes: forms ureteric bud 	Permanent
Features	analogous to kidney of fish	analogous to kidney of amphibians	



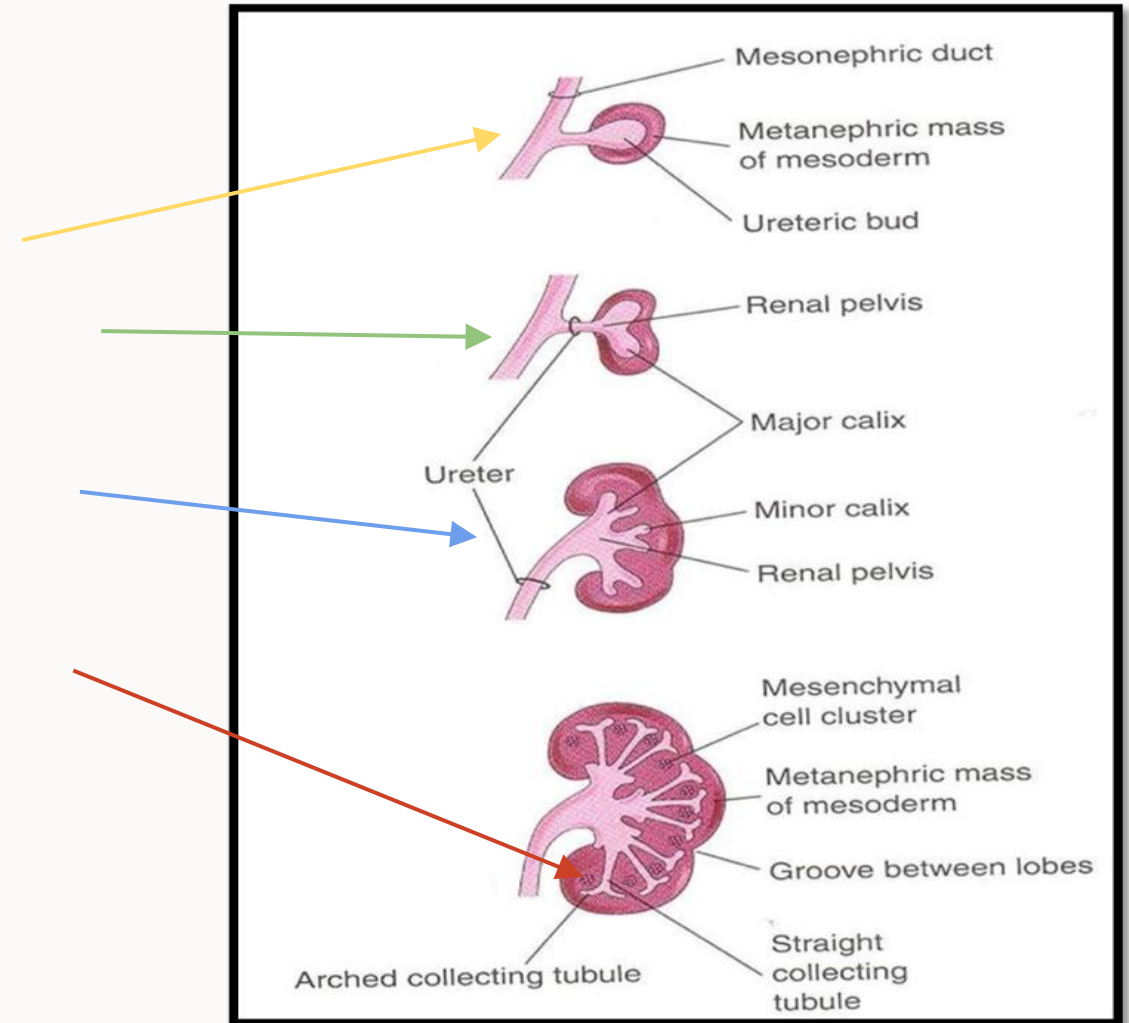
❖ COLLECTING PART OF THE KIDNEY

A- Ureteric bud elongates and penetrates metanephric mass.

B- Stalk of ureteric bud forms **ureter** & its cranial end forms **renal pelvis**.

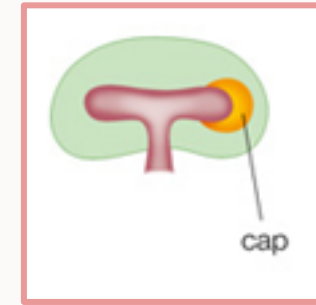
C- Branching of renal pelvis gives **3 major calices**. Branching of major calyces gives **minor calyces**.

D- Continuous branching gives **straight & arched** collecting tubules

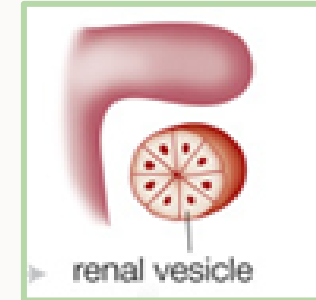


❖ EXCRETORY PART

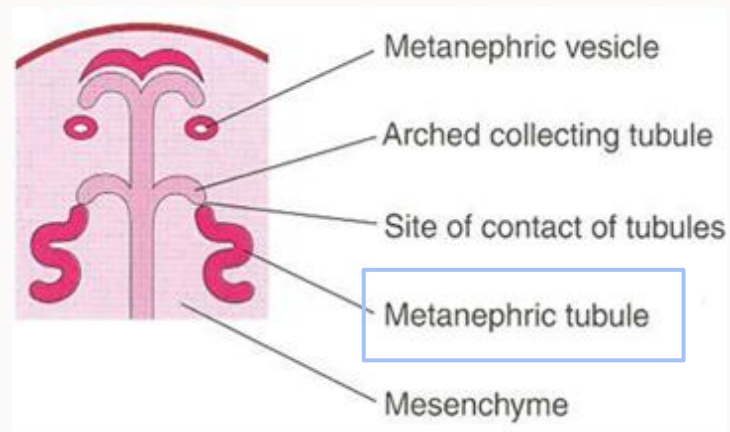
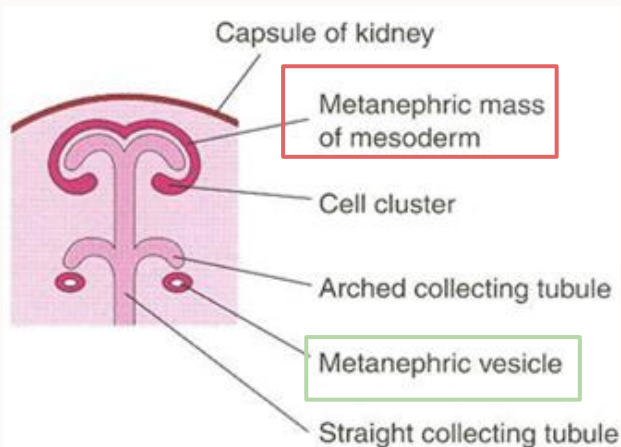
Each **arched collecting tubule** is surrounded by a **cap of metanephric mass**.



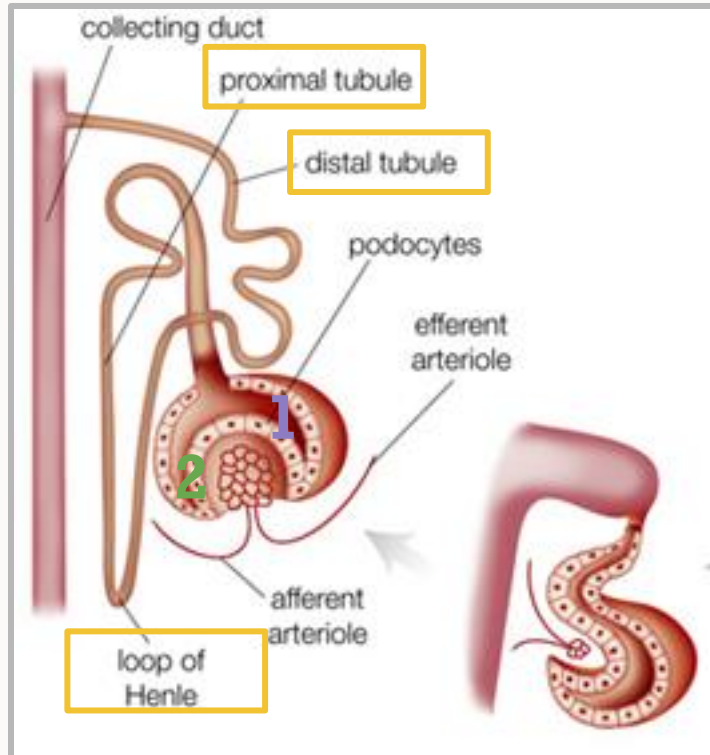
the **metanephric vesicle** is formed .



The metanephric vesicle **elongates** to form an **S-shaped metanephric tubule**.



EXCRETORY PART



1- The end of each tubule forms **Glomerular (Bowman's) capsule.**

2- Each glomerular capsule is invaginated by capillaries (Glomerulus).

3- The tubule lengthens to form: **Proximal & Distal convoluted tubules + Loop of Henle**

THE NEPHRON

THE NEPHRON : is the **functional unit** of the kidney and is formed by **fusion of** :

1) **Excretory tubule** (from **metanephric mass (cap)**).

1) **Arched collecting tubule** (from **ureteric bud**).

At Full Term:

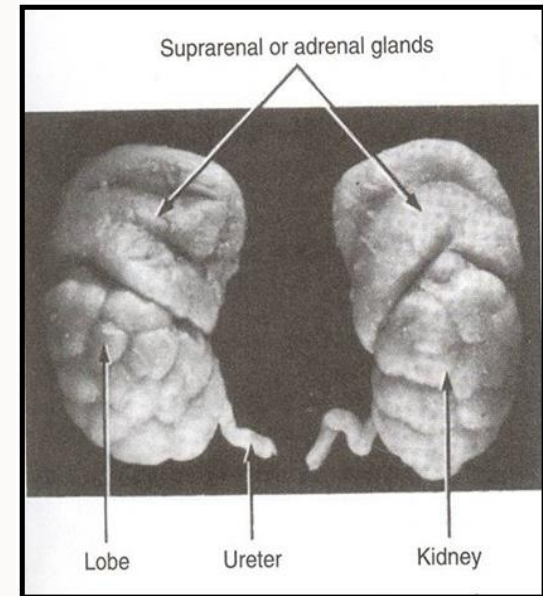
Each kidney contains: **800000 – 1000000** nephrons.

NOTE: the number of nephrons **Does Not increase** after birth it may decrease due to injury but it **Never increase**

The Kidney is subdivided into **Lobes** that are visible externally.

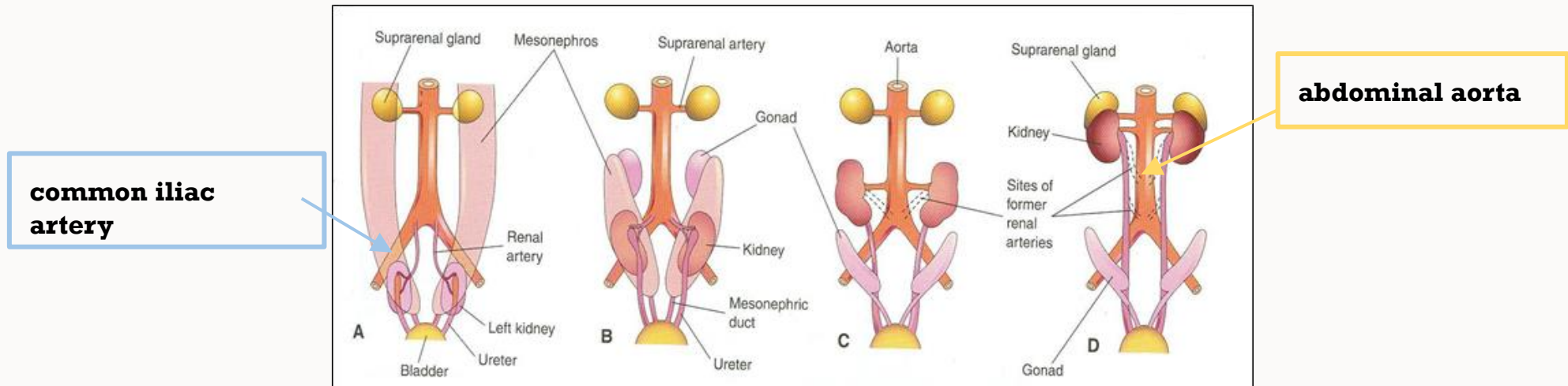
Lobulation **diminishes** at the end of fetal period.

Nephron formation is **complete at birth**.



❖ CHANGES OF KIDNEY BEFORE BIRTH

	Changes from	To
Position	The kidney <u>ascends</u> from <u>pelvis</u>	<u>caudal</u> to <u>suprarenal gland</u> <ul style="list-style-type: none"> • adult position • abdominal region
Blood supply	renal branches of common iliac arteries	renal branches of abdominal aorta.
Rotation	Initially, the <u>Hilum is ventral</u>	then <u>rotates medially</u> about 90° & becomes medial.



❖ CHANGES OF THE KIDNEY



During the 9th week	Changes after birth
start of function	Increase in size due to:
The kidney attains its adult position .	-elongation of tubules .
Receives its arterial supply from abdominal aorta .	-increase in connective tissue between tubules (Not due to increase in number of nephrons)
The hilum is rotated medially	Disappearance of kidney lobulation

❖ CONGENITAL ANOMALIES

A. **Pelvic kidney**: **Failure** of **ascent** of one kidney

B. **Horseshoe kidney**: The **Poles** of both kidneys **fuse**.

(lower position but **normal function**)

C- **Unilateral renal agenesis**: due to **Absence** of one ureteric bud

D- **Supernumerary kidney**: due to **Development** of 2 ureteric buds

E- **Right side**: **Malrotation** of kidney

Left side: **Bifid ureter** & **supernumerary kidney**



Summary of the development of kidneys

The embryological origin	Intermediate mesoderm
The systems during the development	<p>-PRonephric At the beginning of 4th week</p> <p>-MESonephric At the end of 4th week</p> <p>-METAnephric At the 5th week but start to function at the 9th</p>
The formation of the METANEPHROS (PERMANENT KIDNEY)	<p>-Ureteric Bud >from mesonephric > Collecting part of kidney .</p> <p>-Metanephric Blastema > from nephrogenic cord >Excretory part of kidney</p>
THE NEPHRON (FUNCTIONAL UNIT OF KIDNEY)	<p>-Excretory tubule >from metanephric mass</p> <p>-Arched collecting tubule >from ureteric bud</p>
The Fetal Kidney	<p>-Lobulation diminishes at the end of fetal period.</p> <p>-Nephron formation is complete at birth.</p>
CHANGES of kidney Before Birth	<p>Position: The kidney ascends from pelvis to abdomen</p> <p>Blood Supply: changes from branches of common iliac A > into branches of abdominal aorta.</p> <p>Rotation: rotates 90° medially .</p>

Summary of the Congenital Anomalies

1: Pelvic kidney

failure of ascent of one kidney (ureter is short)

2: Horseshoe kidney

the poles of both kidneys fuse: the kidneys have a lower position than normal but have normal function

3: Unilateral renal agenesis

due to absence of one ureteric bud

4: Supernumerary kidney

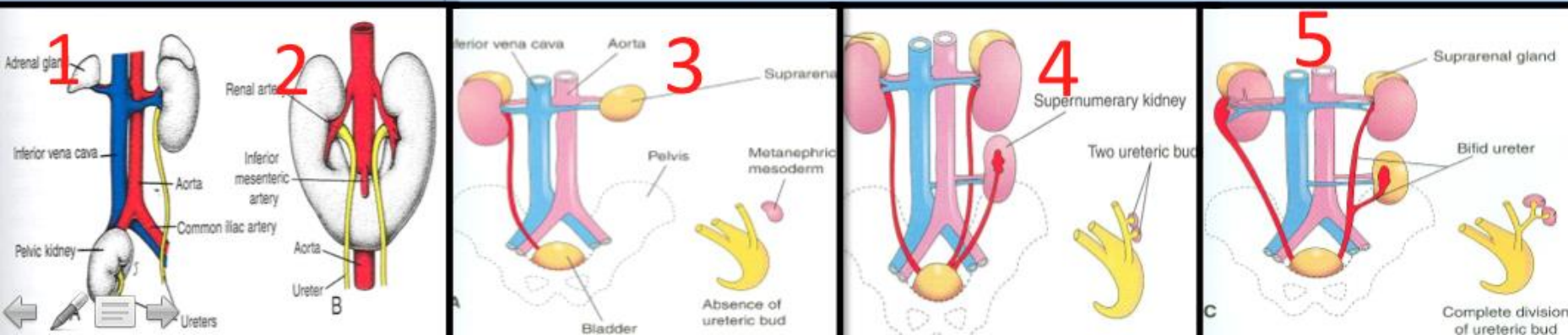
due to development of 2 ureteric buds

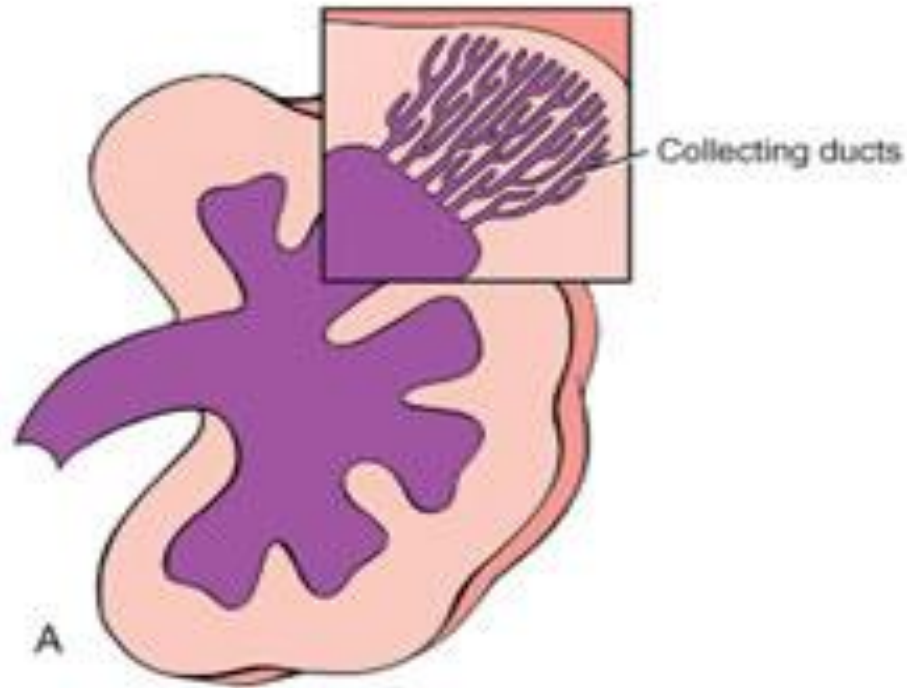
5: Right side

malrotation of kidney

5: Left side

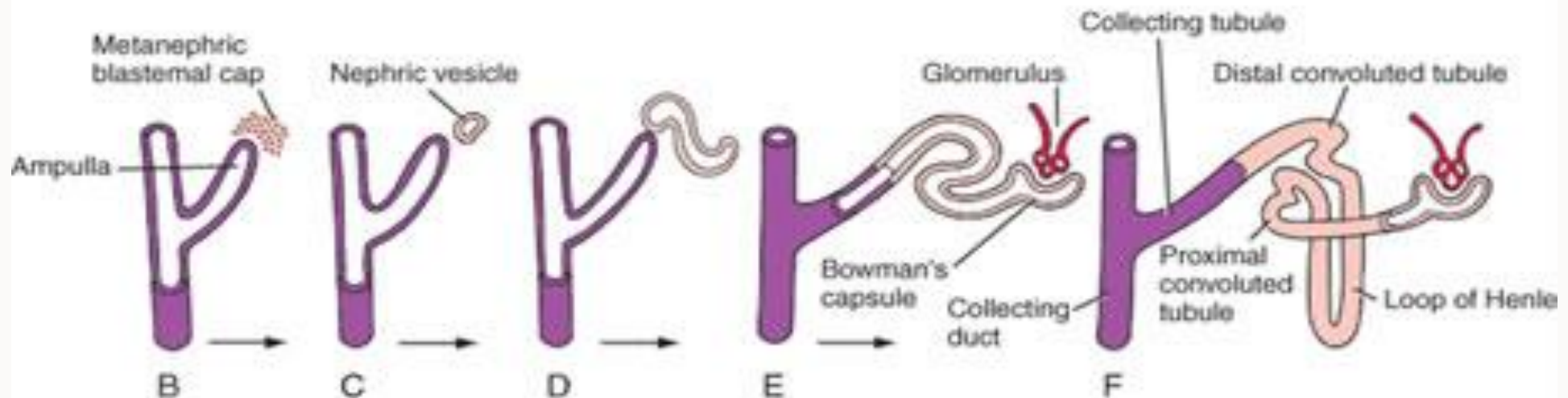
bifid ureter & supernumerary kidney





Useful Video :

https://www.youtube.com/watch?v=yigznAyh nGo&list=PLezrE0Ume 1TpfNYZeol_nEZW62T 1PCL9G



❖ MULTIPLE CHOICES QUESTIONS

1-The sequential development of the renal structures within intermediate mesoderm can best be described as:

- a- Pronephros , mesonephros, metanephros
- b- Pronephros,metanephros,mesonephros
- c- Mesonephric duct, paramesonephric duct,metanephros
- d- Ureteric bud, ureter, urinary bladder

2-The lower end of the mesonephric duct branches to form the:

- a- Uterus bud
- b- Ureteric bud
- c- Urethral bud
- d- Gonadal bud

3-Failure of the ureteric bud to form results in:

- a- Urachal fistula
- b- Pelvic kidney
- c- Renal agenesis
- d- Congenital polycystic kidney

4-what happens to the pronephric system?

- a- Disappears in both sexes
- b- Disappears in males but stays in females
- c- Disappears in females and stays in males
- d- Stays in both sexes

5- what do we mean by 'pelvic kidney'?

- a- Both lower lobes of the kidneys fuse
- b- Failure of ascent of both kidneys
- c- Ureter is short in both kidneys
- d- Failure of ascent of one kidney



- 1-a
- 2-b
- 3-c
- 4-a
- 5-d

❖ SHORT ANSWERS QUESTIONS

What does each of the following differentiates into?

Nephrogenic ridge (forms kidney and uterus)

Gonadal ridge forms gonads (testes or ovaries)

What is the origin of the Kidney?

Intermediate mesoderm

Mention the beginning of each of the following systems in the body?

Pronephric system: Begning of 4th week

Mesonephric system: End of 4th week

Metanephric system: 5th week and function on 9th week

What is the functional unit of the kidney and what is formed of?

Nephrons and formed by the fusion of Excretory tubule and arched collecting tubules

Branching of renal pelvis gives which also gives then continue branching and gives ?

3 major calices .. minor calyces .. straight and arched collecting tubules



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