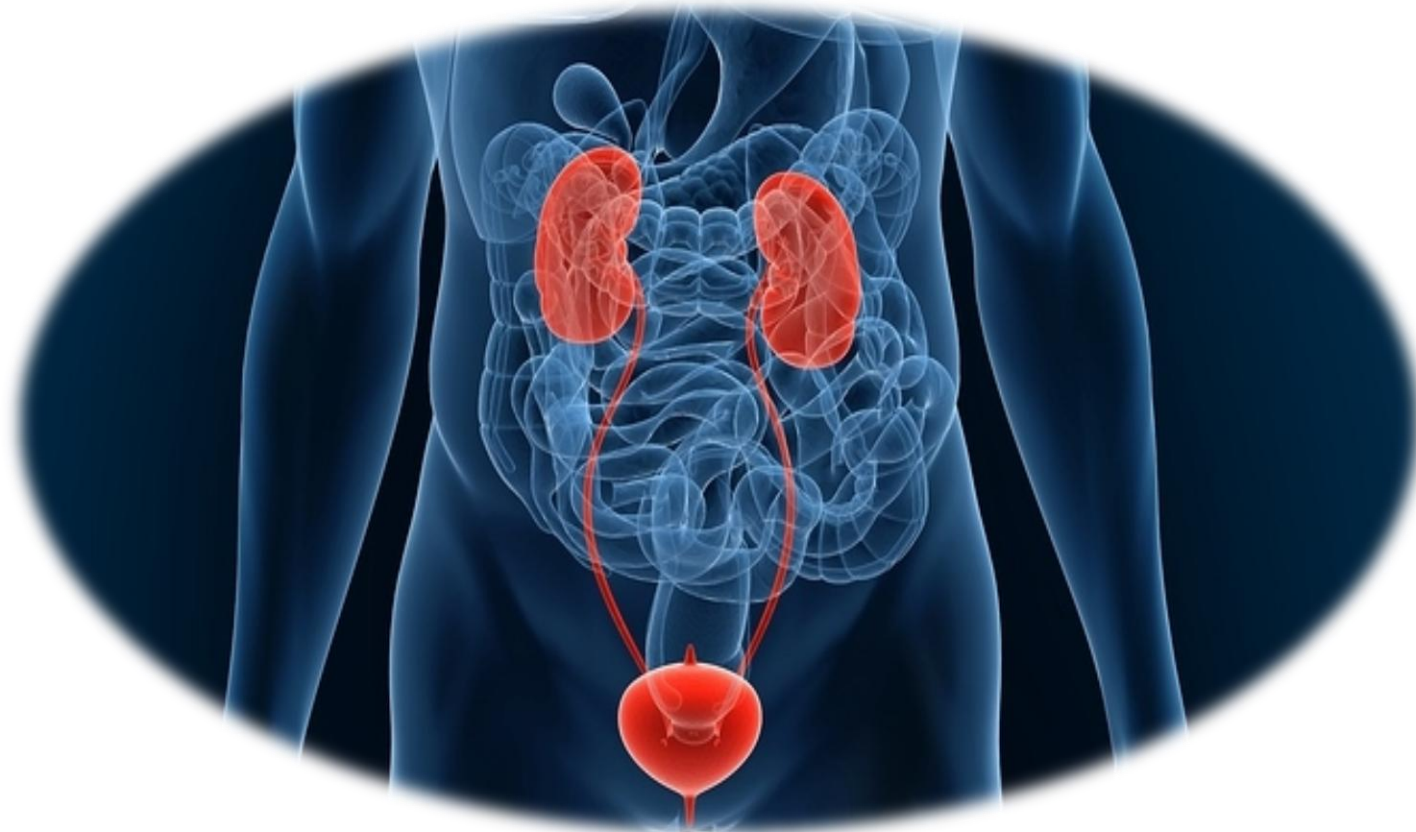


Embryology

Renal Block



Lecture1- Development of kidneys & ureters



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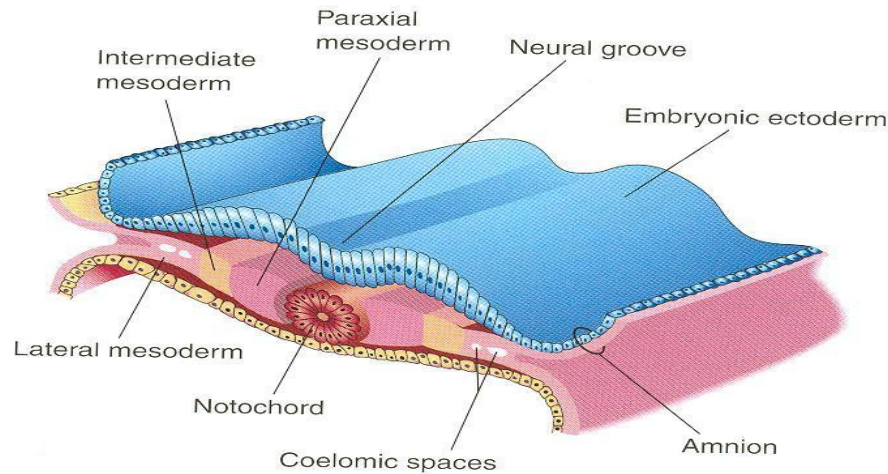


OBJECTIVES

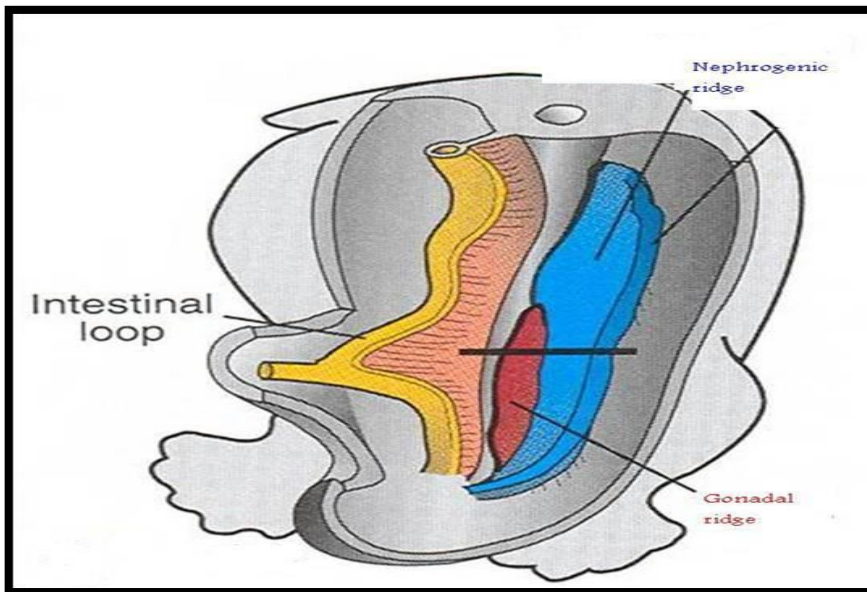
At the end of the lecture, students should be able to:

- ❑ **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 &*

[Development of kidneys & ureters]



KIDNEYS & URETERS
EMBRYOLOGICAL
ORIGIN from
INTERMEDIATE
MESODERM



INTERMEDIATE
MESODERM
Divides into:

- 1. Nephrogenic ridge (cord):**
forms kidneys & ureters
- 2. Gonadal ridge:** forms gonads (testes or ovaries)

[Development of kidneys & ureters]

DEVELOPMENT OF KIDNEYS

Three systems of kidneys develop:

1-Pronephric system: appears at beginning of 4th week
in cervical region

analogous to kidney of fish
formed of tubules & a duct
not function in human
disappears

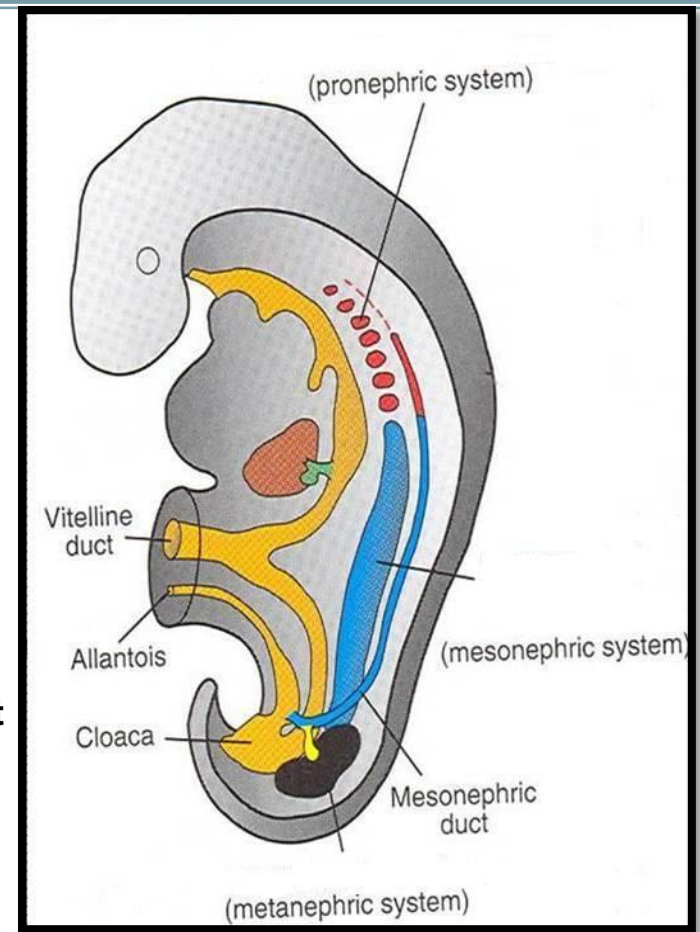
2-Mesonephric system:

appears at end of 4th week
in thoracic & abdominal regions,
analogous to kidney of amphibians, formed of tubules & a duct
function temporarily

In male: forms **genital duct**

In both sexes: forms **ureteric bud**

3-Metanephric system: appears at 5th week in pelvis, starts to **function** at 9th week



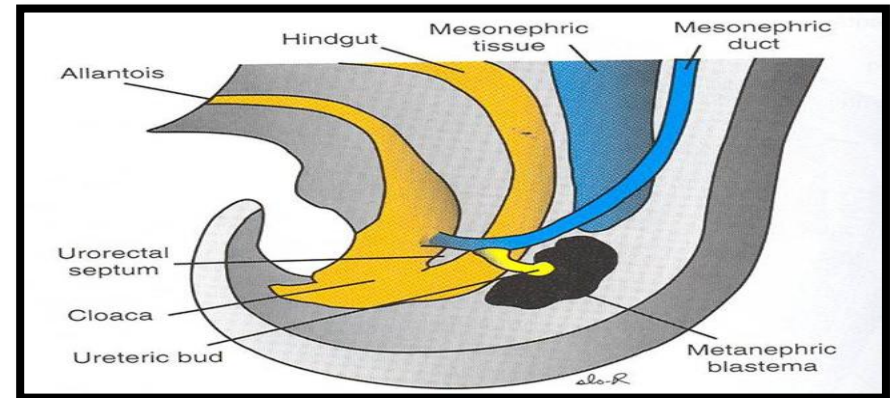
[Development of kidneys & ureters]

METANEPHROS

(PERMANENT KIDNEY)

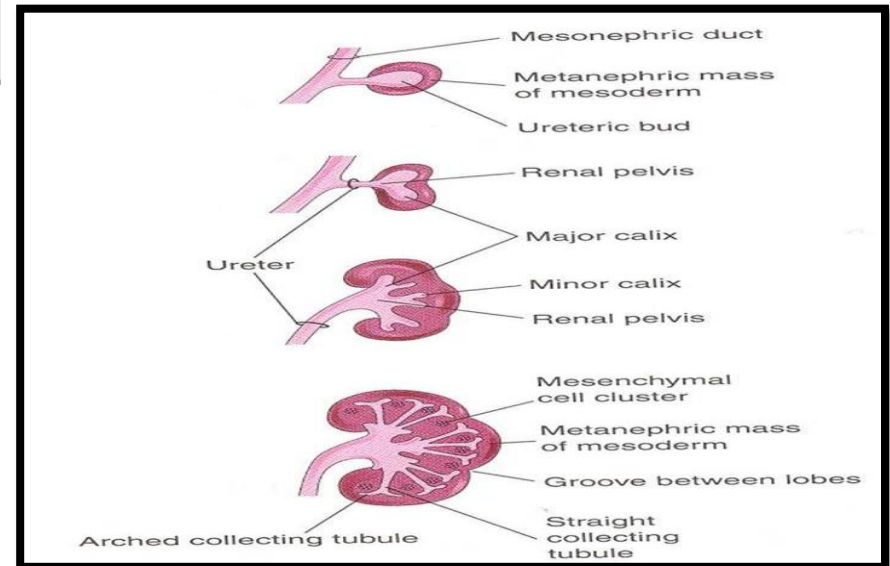
Formed of 2 origins:

- 1) **Ureteric bud**(derived from mesonephric duct): gives **collecting** part of kidney
- 2) **Metanephric blastema (mass)**: gives **excretory** part of kidney



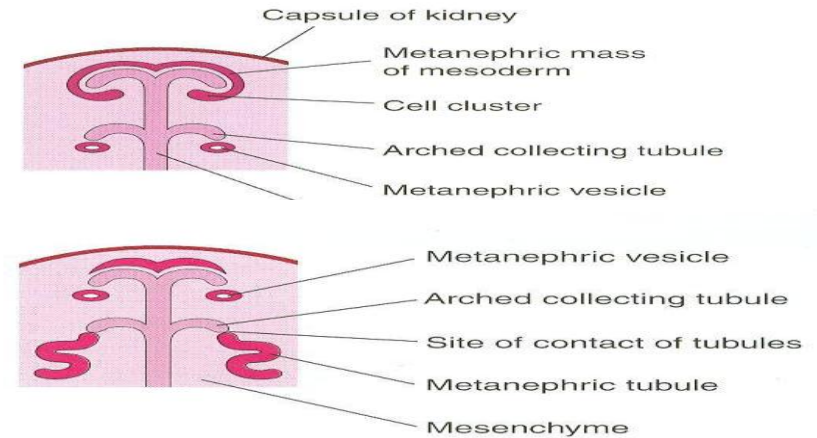
COLLECTING PART

- A- Ureteric bud elongates & penetrates metanephric mass.
- B- Stalk of ureteric bud forms ureter & 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 then arched

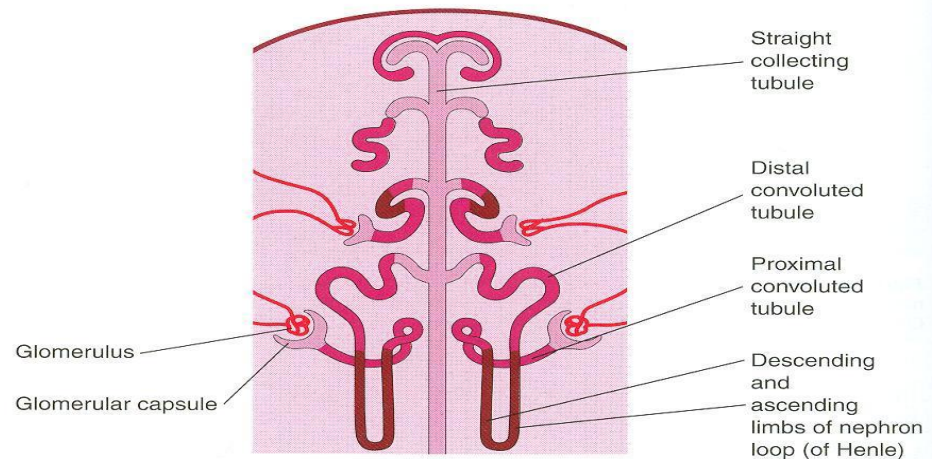


EXCRETORY PART

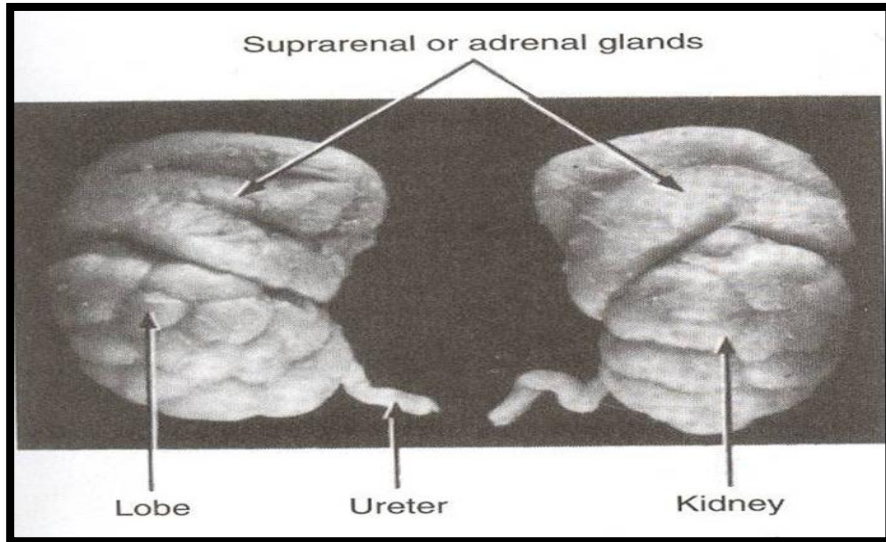
- Each arched collecting tubule is surrounded by a cap of metanephric mass.
- The metanephric cap forms the metanephric vesicle.
- The metanephric vesicle elongates to form an S-shaped metanephric tubule.



- The end of each tubule forms **glomerular (Bowman's) capsule**.
- Each glomerular capsule is invaginated by capillaries (**glomerulus**).
- The tubule lengthens to form: **proximal & distal convoluted tubules + loop of Henle**

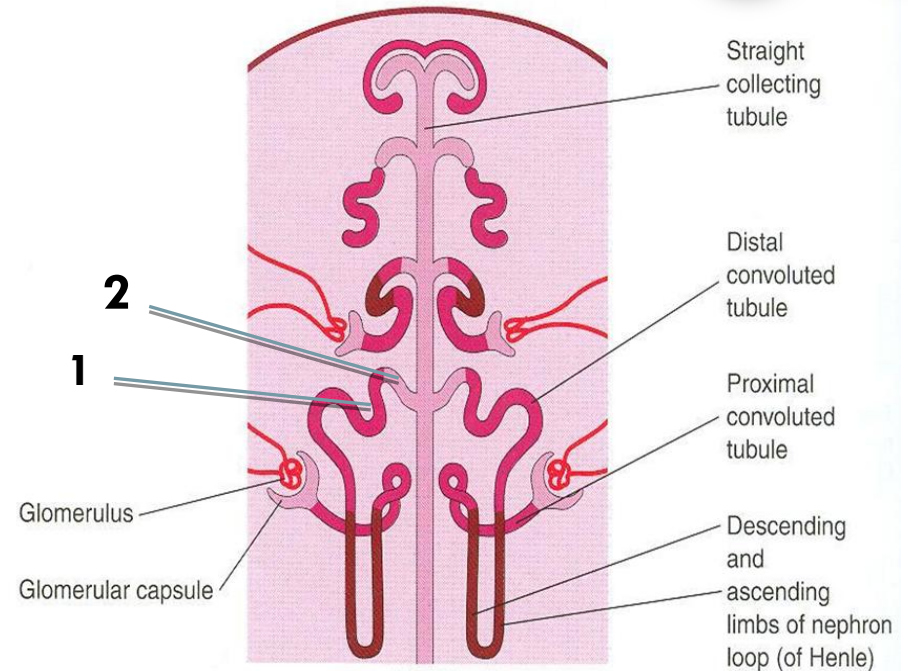


[Development of kidneys & ureters]



THE FETAL KIDNEY

- # Glomerular filtration begins at 9th week.
- # At 9th week, kidney attains its adult position & receives its supply from renal artery, its hilum is rotated medially.
- # Kidney is subdivided into lobes that are visible externally. Lobulation diminishes at the end of fetal period.
- # Nephron formation is complete at birth.



THE NEPHRON

FUNCTIONAL UNIT OF KIDNEY

- The nephron is formed by fusion of:
- 1- Excretory tubule formed of metanephric mass (cap).
 - 2- Arched collecting tubule formed of ureteric bud.
- # **At full term**, each kidney contains: 800000 – 1000000 nephrons.

[Development of kidneys & ureters]

**CHANGES DURING DEVELOPMENT
(BY 9TH WEEK)**

Change in position: The kidney ascends from pelvis to abdomen & attains its adult position, caudal to suprarenal gland.

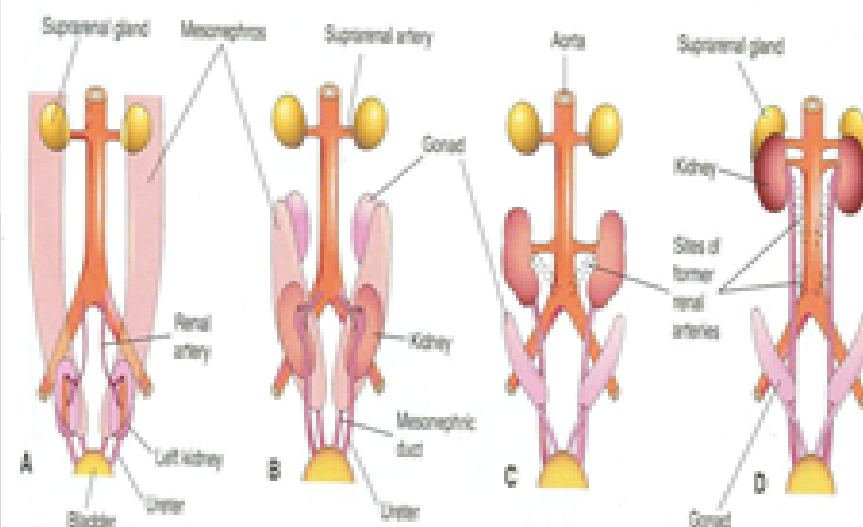
Change in blood supply: As the kidney ascends, its blood supply changes from renal branches of common iliac arteries into renal branches of abdominal aorta.

Rotation: Initially, hilum (site of entry & exit of vessels & nerves) is ventral then rotates medially about 90° & becomes medial.

CHANGES AFTER BIRTH

Increase in size: due to elongation of tubules and increase in connective tissue between tubules (not due to increase in number of nephrons)

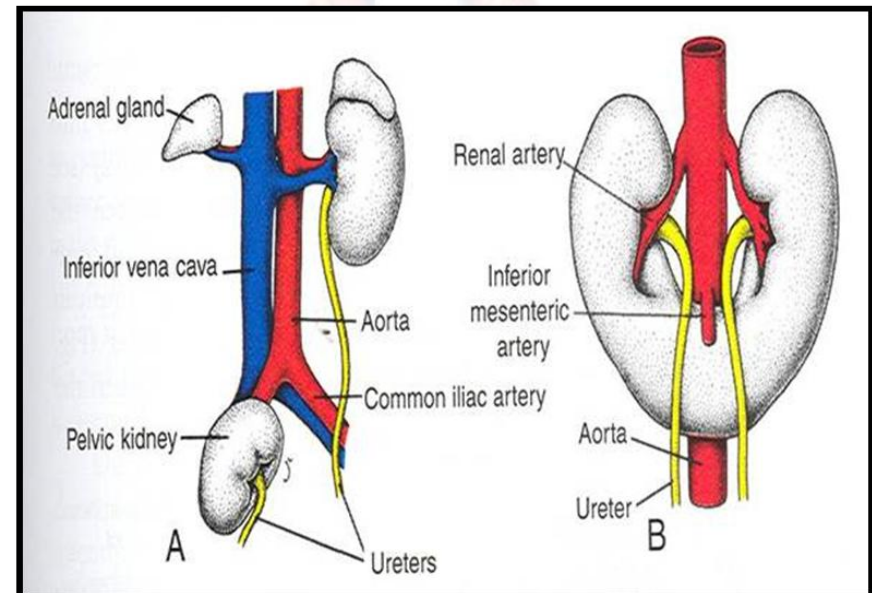
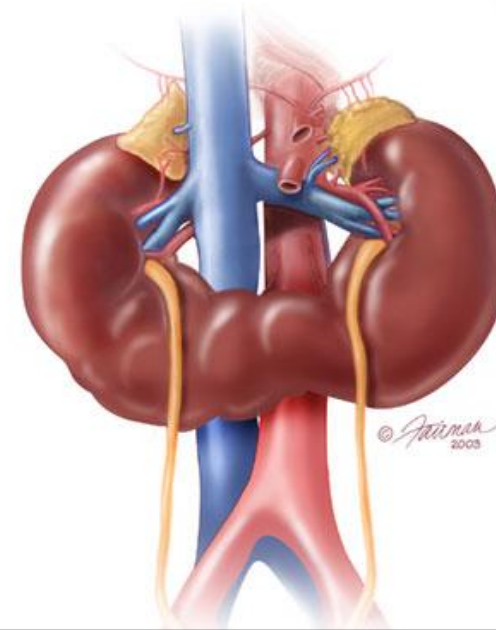
Disappearance of kidney lobulation



Anomalies

A- Pelvic kidney: failure of ascent of one kidney (ureter is short)

B- Horseshoe kidney: the poles of both kidneys (usually the lower poles) fuse: the kidneys have a lower position than normal but have normal function (sometimes, may Block the inferior mesenteric artery)



[Development of kidneys & ureters]

Anomalies

<p>Unilateral renal agenesis: due to absence of one ureteric bud</p>	<p>Supernumerary kidney: due to development of 2 ureteric buds</p>	<p>Right side: malrotation of kidney Left side: bifid ureter & supernumerary kidney</p>
<p>A</p>	<p>B</p>	<p>C</p>

[Development of kidneys & ureters]

TIME LINE

BY 4th week:

*Appearance of Pronephric system (*beginning of*)

*Appearance of Mesonephric system (*end of*)

BY 5th week:

*Appearance of Metanephric system.

BY 9th week:

*Glomerular Filtration begins.

*Kidney attains its adult position.

*Kidney receives its arterial supply from aorta.

*Kidney completes rotation and become medial

At full term:

*Nephron formation is complete about 800000-1000000 .

*Lobulation of kidney diminishes.

After birth:

*Lobulation disappears.

*Kidney increases in size due to elongation of existing tubules not due to increase in number of nephrons.

[Development of kidneys & ureters]

SUMMARY

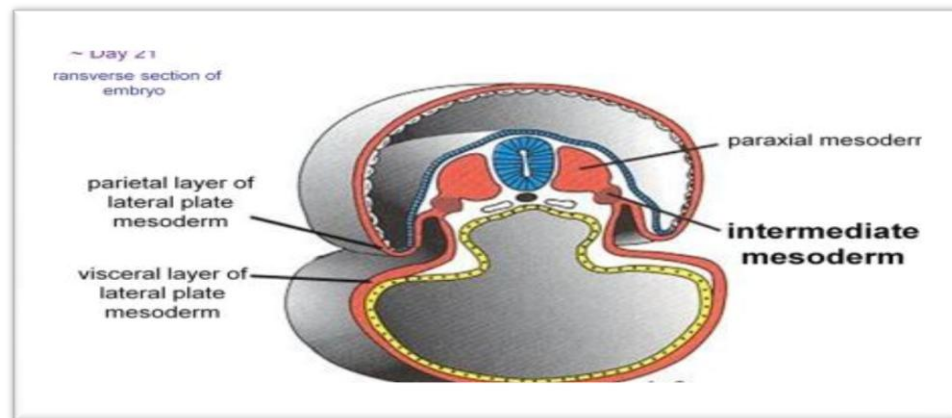
The embryonic disk is composed of three layers:

- **Ectoderm**(origin of CNS&PNS).
- **Mesoderm**.
- **Endoderm** (origin of epithelial part of the body).

Mesoderm itself consists of three parts:

Paraxial/Intermediate/Lateral (somatic&Splanchnic)

Intermediate Mesoderm: The layer which will give rise to **(Urinary System)** by the **Nephrogenic ridge**.



[Development of kidneys & ureters]

There are three systems exist in the (Nephrogenic ridge):

Pronephric

- *The first one exists (at the beginning of the 4th week).*
- *Located in the cervical region.*
- *Origin of the kidney of the fish.*
- *Not functioning in human's body, so it disappears later.*

Mesonephric

- *Exists at the end of the 4th week.*
- *Located in the thoracic/abdominal region.*
- *Origin of the kidney of the amphibians.*
- *Functioning (remains) in human to give rise to :*
 - 1 / Male genital duct.*
 - 2 / Ureteric bud for both sexes.*

Metanephric

- *Exists at the 5th week.*
- *Located in the pelvis.*
- *Gives rise to the excretory part of the kidney (Nephron).*
- *Starts functioning at week 9.*

[Development of kidneys & ureters]

#The Whole functioning kidney (Metanephros) arises from:

1 / Ureteric bud (from Mesonephric system) gives the collecting part.

2 / Metanephric mass or blastema → gives the excretory part.

Collecting part growing steps:

Ureteric bud elongates to penetrate the metanephric mass while it's consisting of:

A/stalk (The future ureter).

B/cranial end (Pelvis of the ureter).

It starts branching to give 3 major calyces which also branches to give minor calyces.

The branching process continues until it finishes as a straight tubule with an arched end.

Excretory part growing steps:

Each arched end or collecting tubule becomes surrounded by a cap of metanephric mass.

This cap then forms a small vesicle which later elongates to form an **S-shaped metanephric tubule.**

Each tubule then forms:

- Bowman's capsule.
- Proximal tubule.
- Distal tubule

✓ **Later on, the excretory and collecting parts fuse to form around 1.000.000 Nephrons.**

[Development of kidneys & ureters]

Some Changes occur at the 9th week:

1/Changing in position: The two kidneys move from pelvis to abdomen until they become located caudal to suprarenal gland.

2/changing in blood supply: from renal branches of common iliac to renal branches of abdominal aorta.

3/Medial rotation: So the hilum of the kidney will be located medially instead of locating anteriorly.

Some Important Notes

- ✓ *Renal filtration process starts at the 9th week.*
- ✓ *Fetal kidney is subdivided into many lobes which is diminished at the end of fetal period, and disappears after birth.*
- ✓ *Nephron formation is completed at birth.*
- ✓ *Two major changes occur after birth:*

1/Increase in kidney's size (due to increase in the amount of connective tissue & Tubular elongation).

2/Disappearance of the lobes.

[Development of kidneys & ureters]

Anomalies:

1/Pelvic Kidney:

At least one of the two kidneys remains in the pelvis, due to failure of Ureteric elongation.

2/Horseshoe Kidney:

Fusion of the poles of the two kidneys.

Usually: The lower poles

3/Unilateral renal agenesis:

Due to absence of one Ureteric bud.

4/Supernumerary Kidney:

Presence of more than two kidneys due to development of two ureteric buds from one mesonephric system.

5/Malrotation.

6/Bifid Ureter that leads to supernumerary kidney.

[Development of kidneys & ureters]

MCQs

1. The kidneys and ureters are arised from:

- A. Proximal mesoderm.
- B. Intermediate mesoderm.**
- C. Lateral mesoderm.
- D. Ectoderm

2. Metanephric system starts function at:

- A. 5th week
- B. 4th week
- C. 9th week**
- D. 10th week

3. Which system gives ureteric bud:

- A. metanephric system.
- B. mesonephric system.**
- C. Pronephric system.

4. Lobulation of kidney diminishes at:

- A. 9th week.
- B. 4th week.
- C. 5th week.
- D. At full term.**
(lobulation disappear)

[Development of kidneys & ureters]

Some Helpful Videos...

Wish you all the best 😊

<http://www.youtube.com/watch?v=yigznAyhnGo>

<http://www.youtube.com/watch?v=zF1hulP2eYg>

http://php.med.unsw.edu.au/embryology/images/7/76/Renal_blood_01.mp4

LUCK!

GOOD

Done By:

AbdulhameedSaeedAlghamdi
Abdulrahman Al-Bahkley
Alwaleed Al Subaie
Abdulelah Al habeeb
Maan Al Herbish
Mesh'alAlfallaj
Abdulateef Al Hasan
Faisal Bazuhair