



DEVELOPMENT OF KIDNEYS & URETERES

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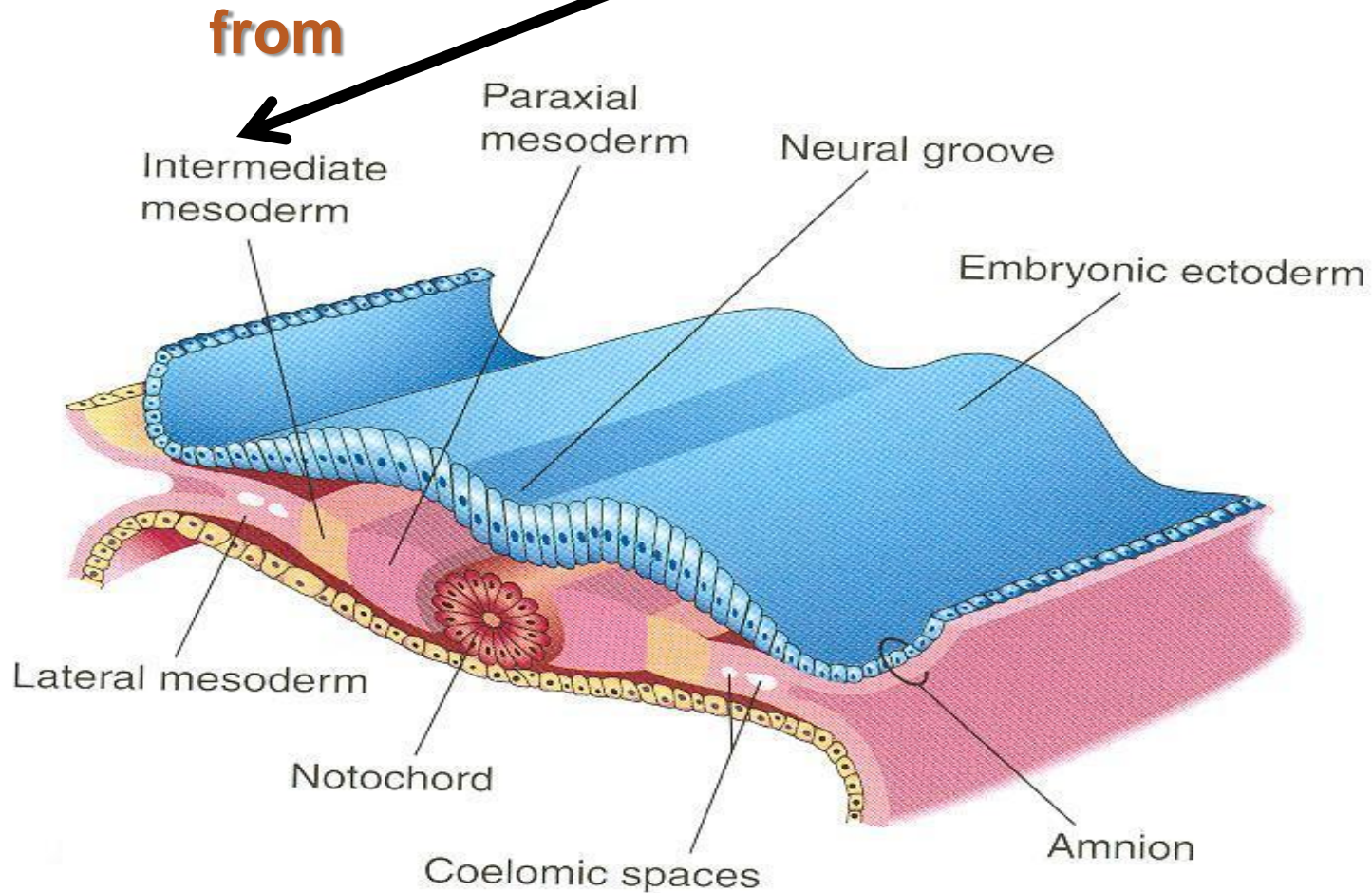
OBJECTIVES

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

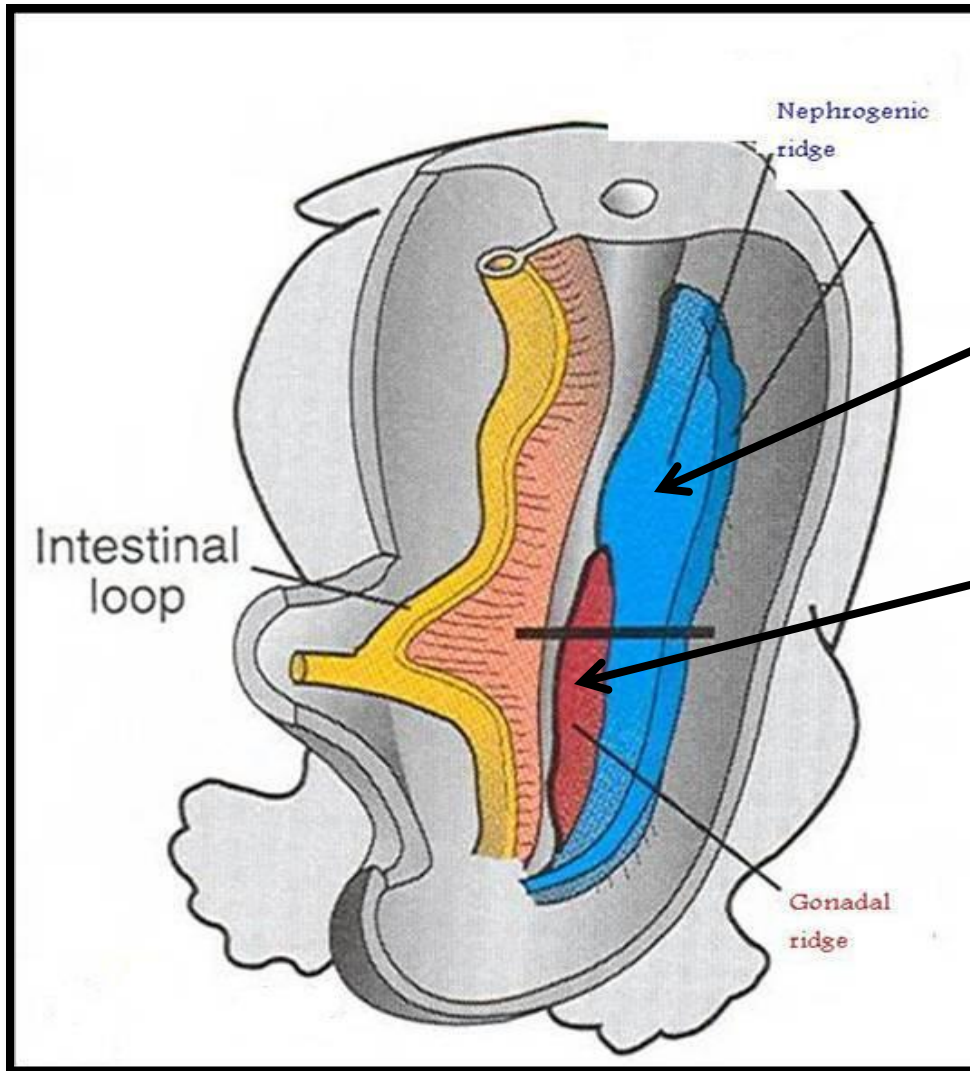
- ❑ ***Identify the embryological origin of kidneys & ureters.***
- ❑ ***Differentiate between the 3 systems of kidneys during development.***
- ❑ ***Describe the development of collecting & excretory parts of permanent kidney.***
- ❑ ***Describe the fetal kidney & identify the pre- and postnatal changes that occur in the kidney.***
- ❑ ***Enumerate the most common anomalies of kidneys & ureters.***

KIDNEYS & URETERS

EMBRYOLOGICAL ORIGIN



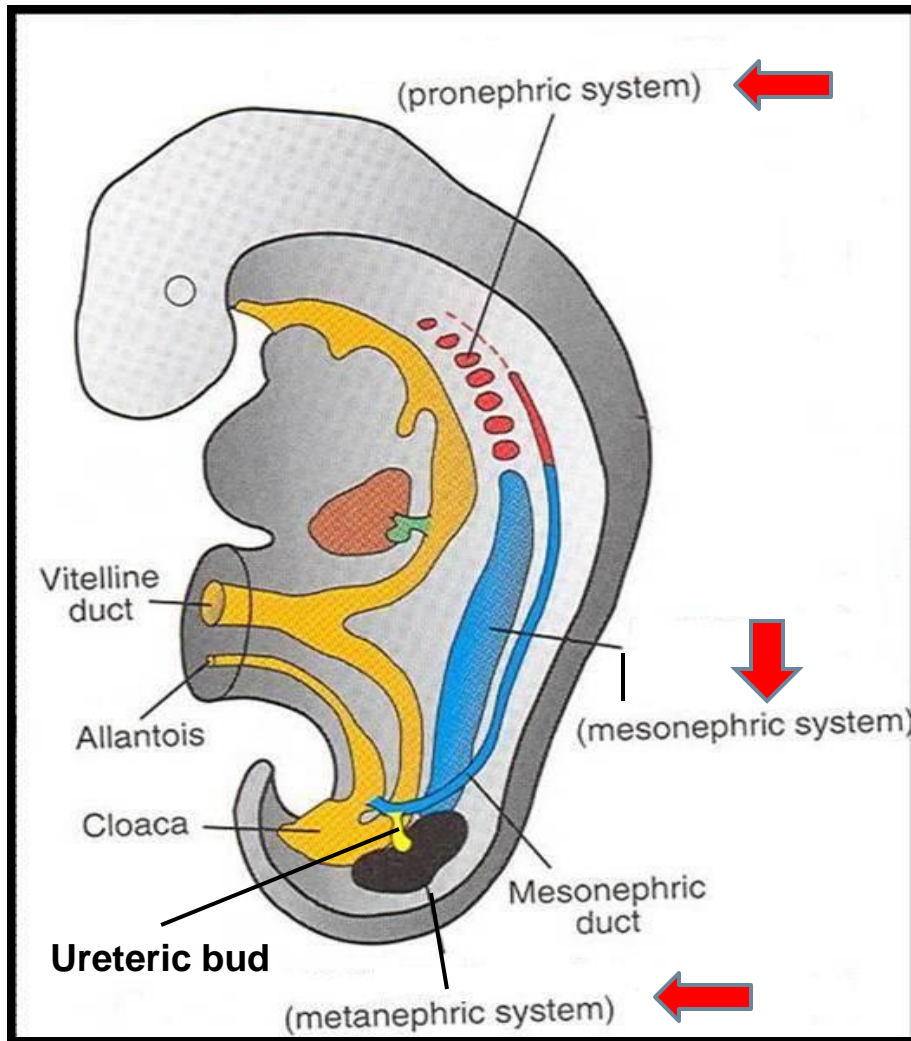
INTERMEDIATE MESODERM



Divides into:

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

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:

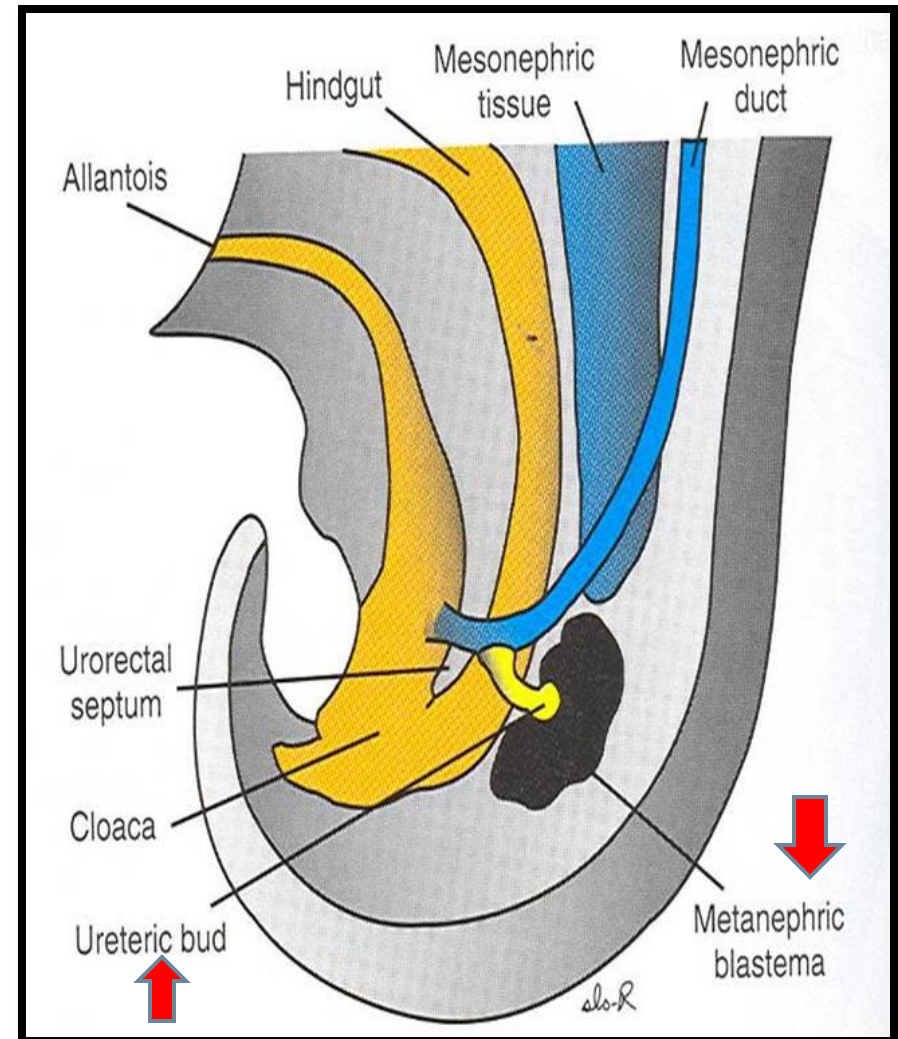
- appears at 5th week in pelvis
- starts to function at 9th week

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**



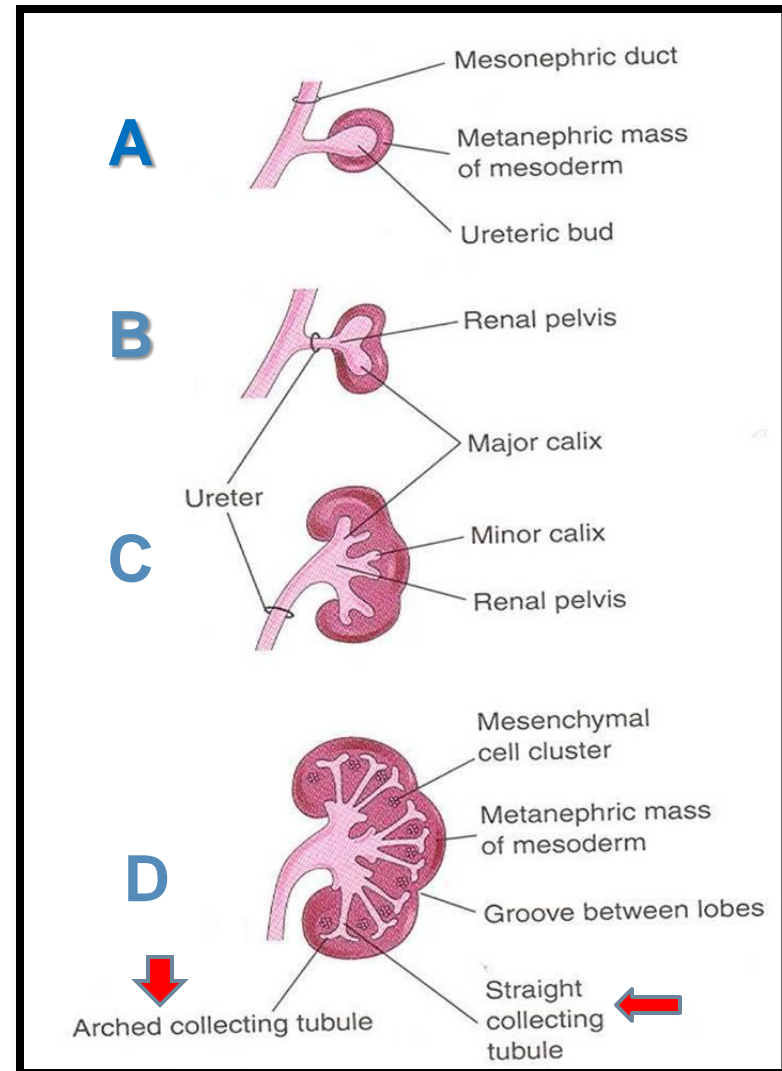
COLLECTING PART

A- Ureteric bud elongates & penetrates metanephric mass.

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

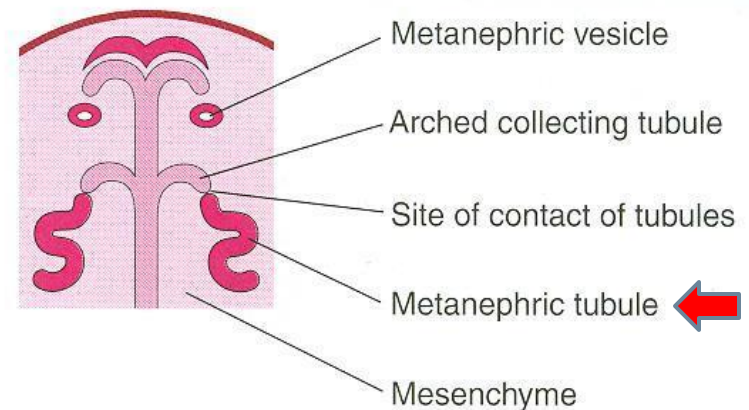
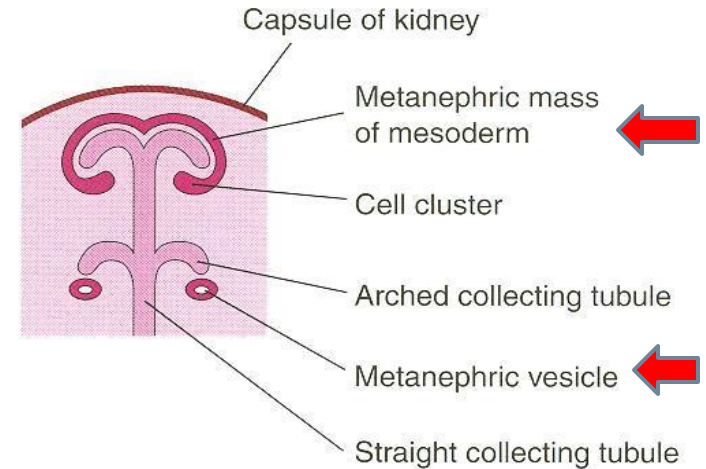
C- Branching of renal pelvis gives 3 major calices. Branching of major calyces gives minor calyces.

D- Continuous branching gives straight then arched collecting tubules



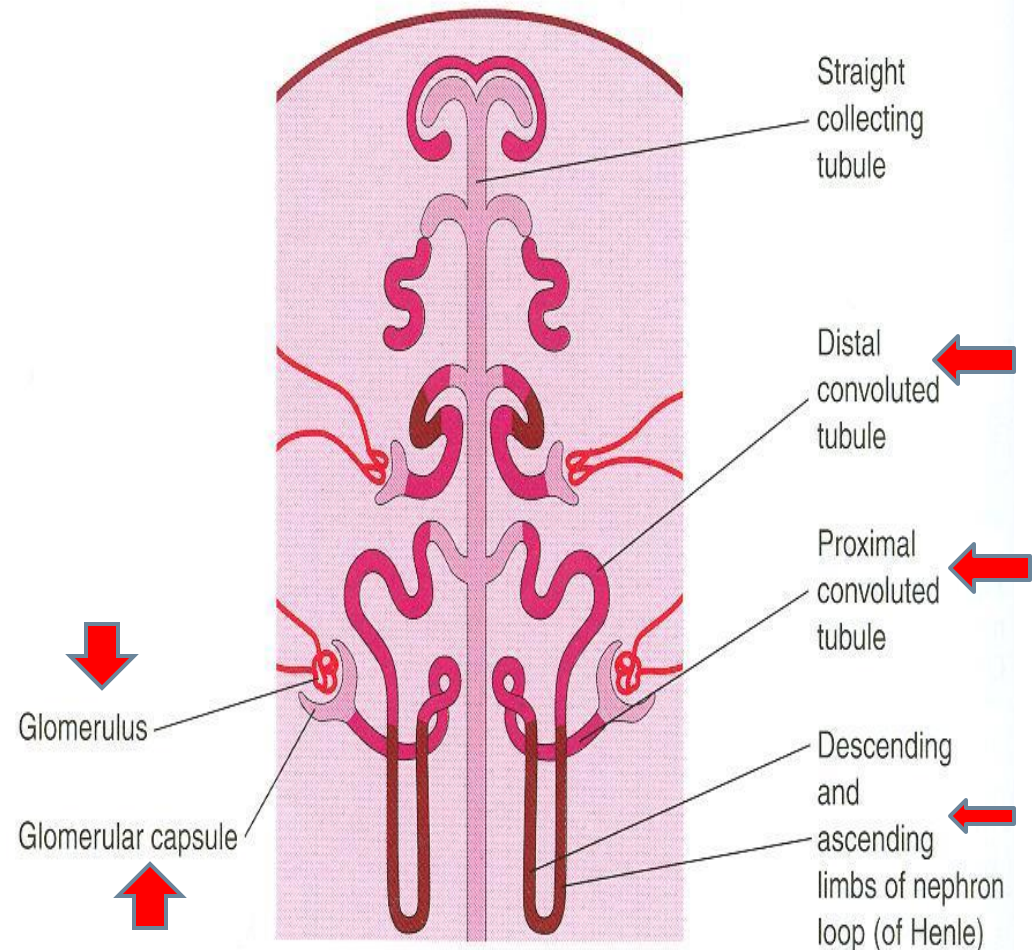
EXCRETORY PART

- 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.



EXCRETORY PART

- 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**



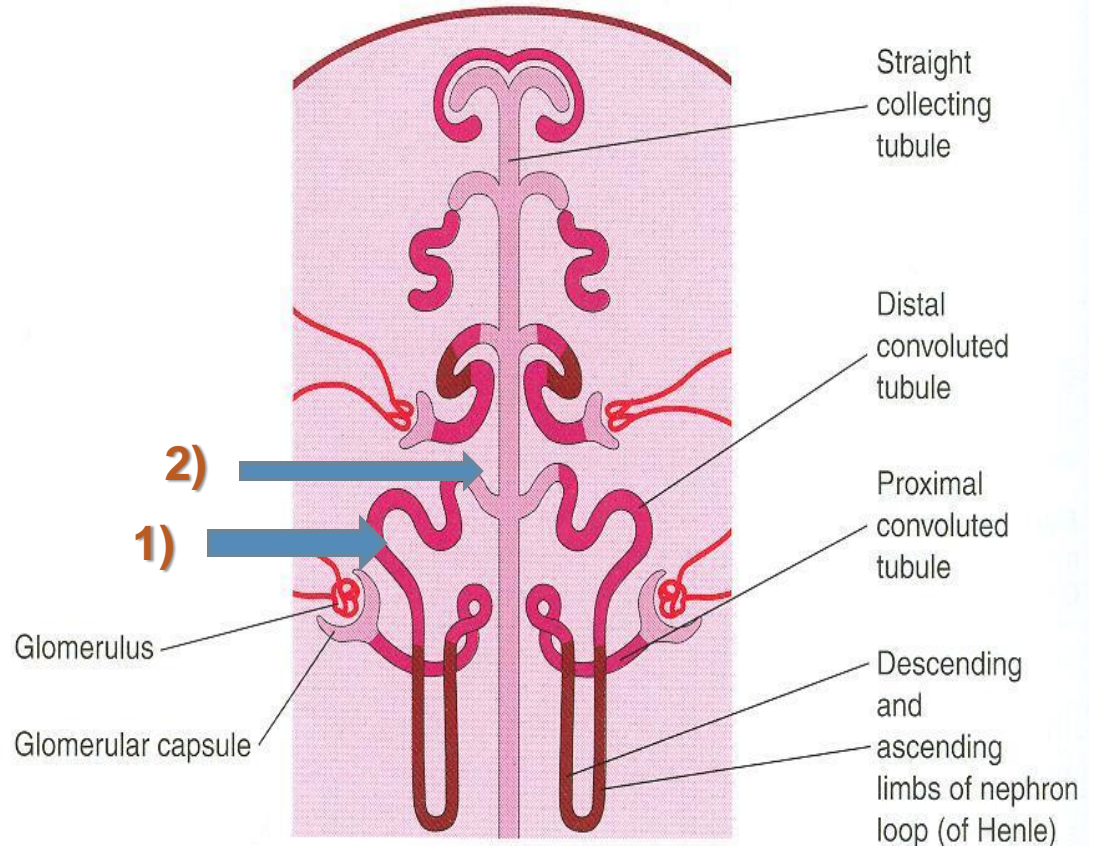
THE NEPHRON

FUNCTIONAL UNIT OF KIDNEY

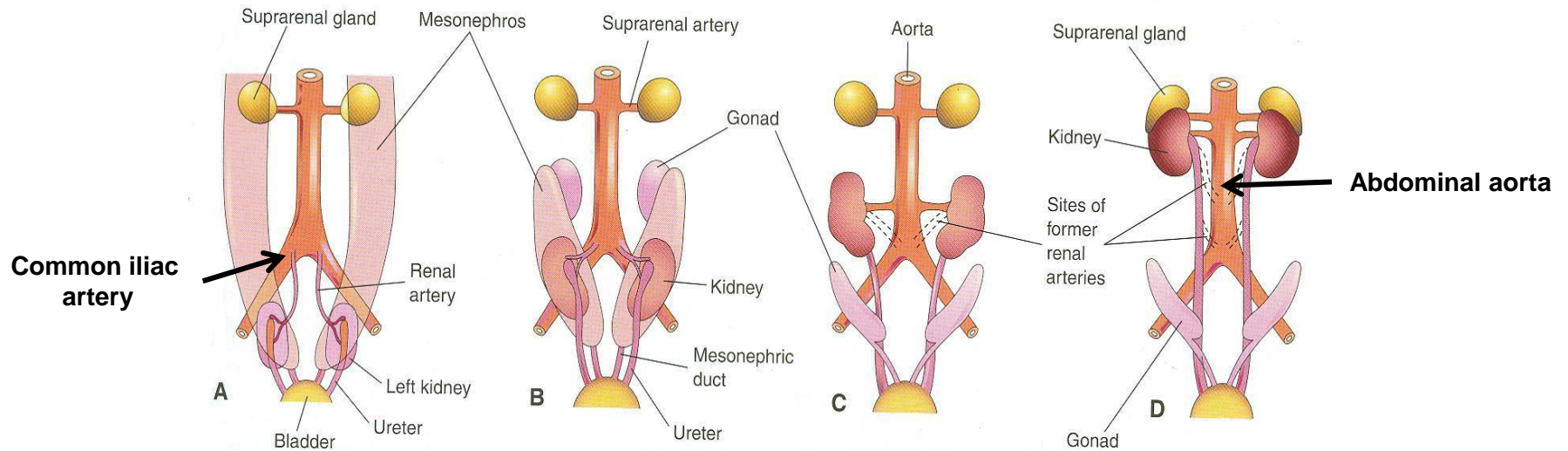
The nephron is formed by fusion of:

- 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.



CHANGES DURING DEVELOPMENT (BY 9TH WEEK)



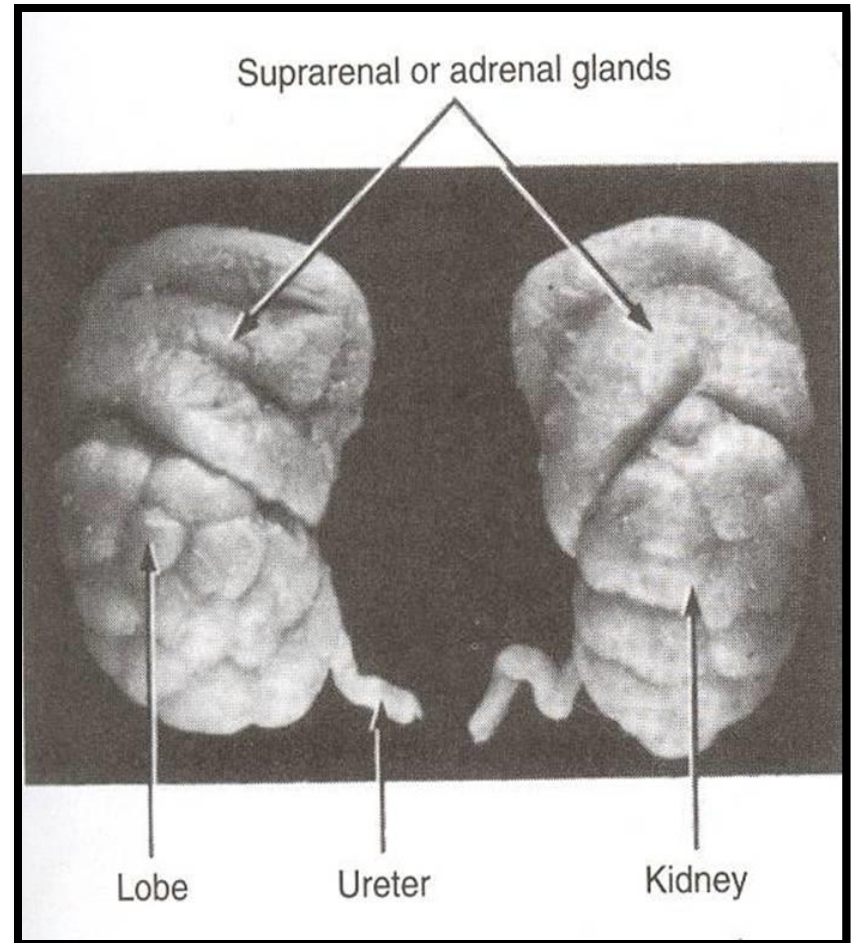
-Change in position: The kidney ascends from pelvis to abdomen & attains its adult position, caudal to suprarenal gland.

-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.

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.**

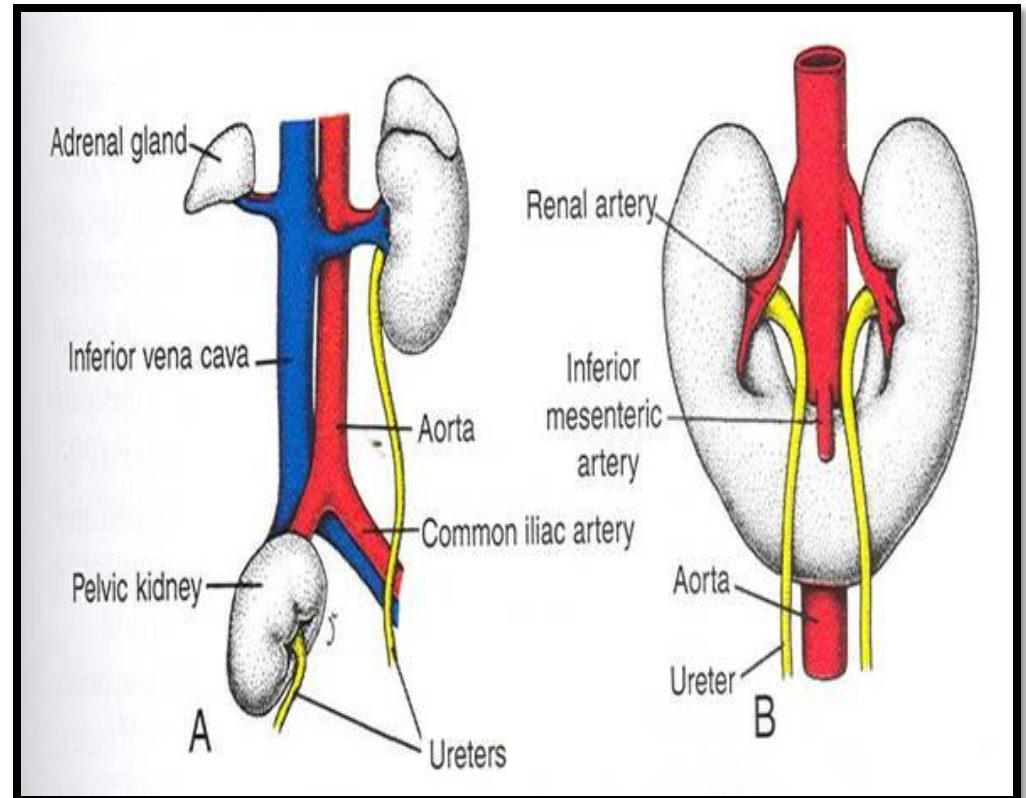


CHANGES AFTER BIRTH

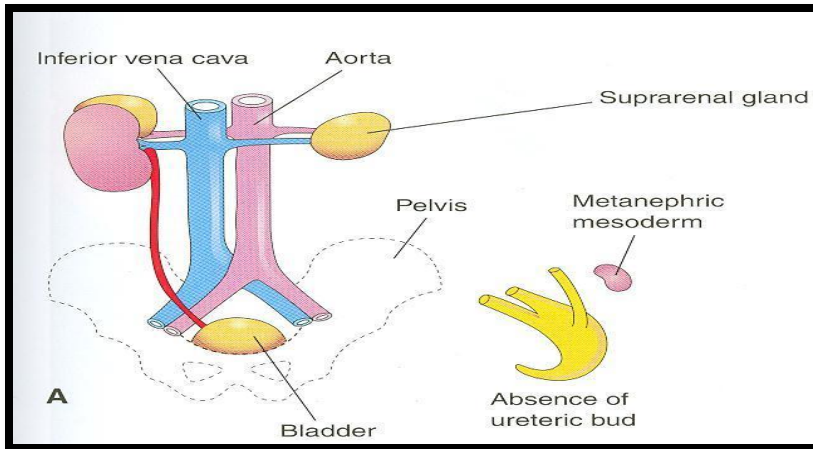
- 1) **Increase in size:** due to elongation of tubules and increase in connective tissue between tubules (not due to increase in number of nephrons)
- 2) **Disappearance of kidney lobulation**

ANOMALIES

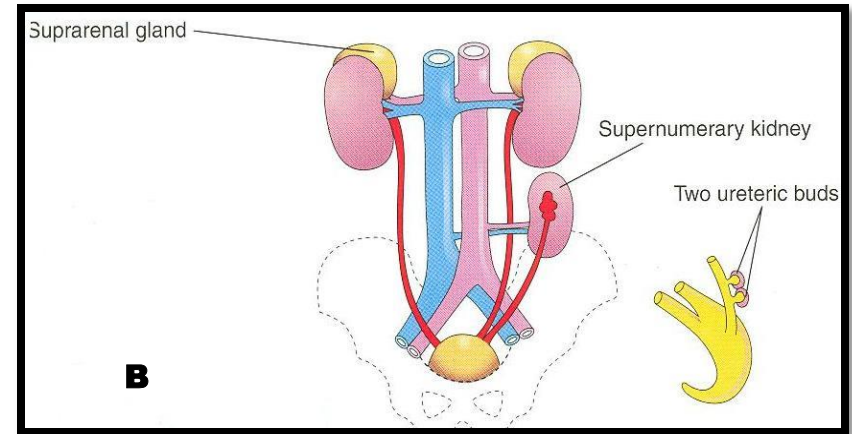
- A. **Pelvic kidney:** failure of ascent of one kidney (ureter is short)
- B. **Horseshoe kidney:** the poles of both kidneys (usually the **lower poles**) fuse: the kidneys have a lower position than normal but have normal function



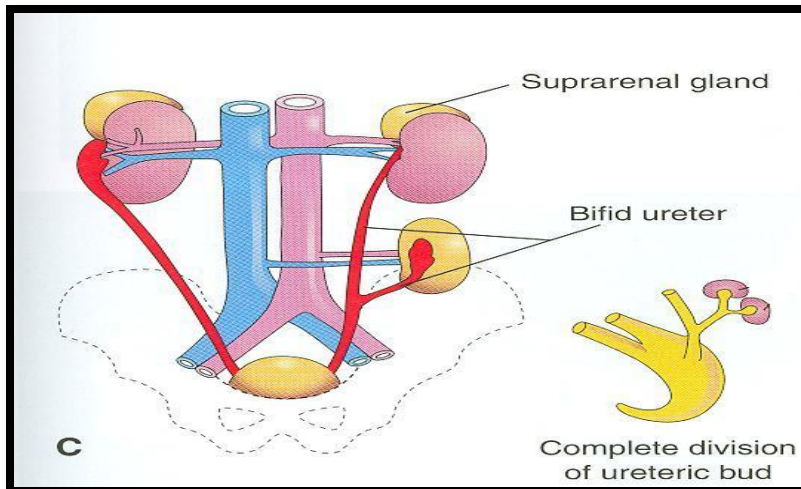
ANOMALIES



A- Unilateral renal agenesis: due to absence of one ureteric bud



B- Supernumerary kidney: due to development of 2 ureteric buds



C- Right side: malrotation of kidney
Left side: bifid ureter & supernumerary kidney

SUMMARY - 1

- Kidneys & ureters originates from nephrogenic ridge (cord) of intermediate mesoderm.
- During development, 3 systems appear:
 - 1) **Pronephric:** *in cervical region*, not function.
 - 2) **Mesonephric:** *in thorax & abdomen*, function temporarily, mesonephric duct gives ureteric bud.
 - 3) **Metanephric:** *in pelvis*, permanent kidney.

SUMMARY - 2

- **Ureteric bud** gives: ureter + collecting part of kidney (calyces, straight & arched collecting tubules).
- **Metanephric mass** gives: excretory part of kidney (Bowman capsule, proximal & distal convoluted tubules, loop of Henle).
- **By 9th week:**
 - 1) Glomerular filtration begins.
 - 2) Kidney attains its adult position.
 - 3) Kidney receives its arterial supply from aorta.
 - 4) Kidney completes rotation.

SUMMARY - 3

- **At full term:**

- 1) **Nephron formation is complete.**
- 2) **Lobulation of kidney diminishes.**

- **After birth:**

- 1) **Lobulation of kidney disappears.**
- 2) **Kidney increases in size due to elongation of existing tubules not due to increase in number of nephrons.**

QUESTIONS



QUESTION 1

- Which one of the following events happens by 9th week?
 - 1) Nephron formation is complete
 - 2) Disappearance of kidney lobulation
 - 3) Kidney attains its adult position ←
 - 4) Metanephric system appears

QUESTION 2

- Which one of the following structures is a derivative of the ureteric bud?
 - 1) Major calyces ←
 - 2) Loop of Henle
 - 3) Glomerulus
 - 4) Proximal convoluted tubule

THANK YOU

