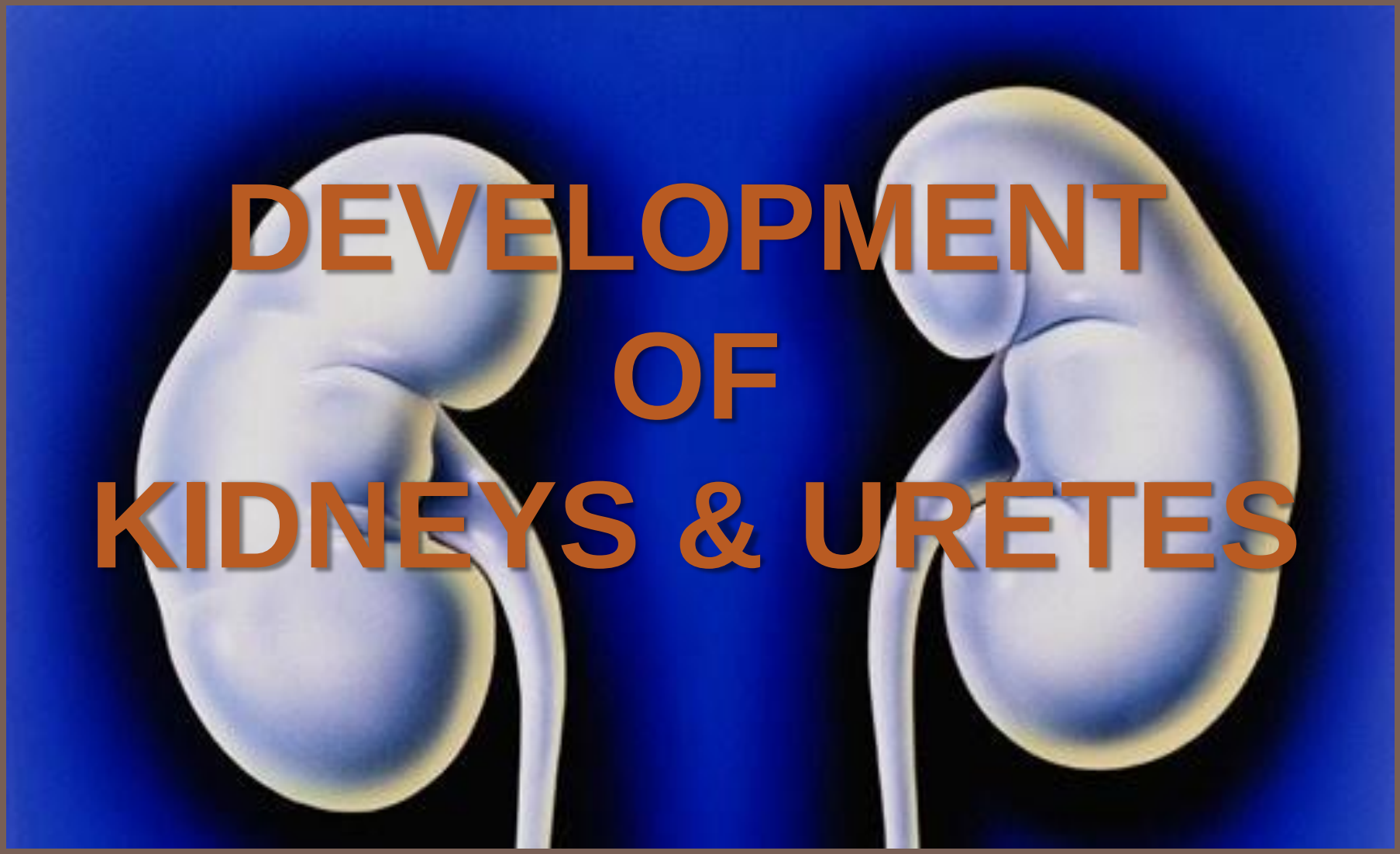


DEVELOPMENT OF KIDNEYS & URETES

Prof. Ahmed Fathalla Ibrahim

OBJECTIVES

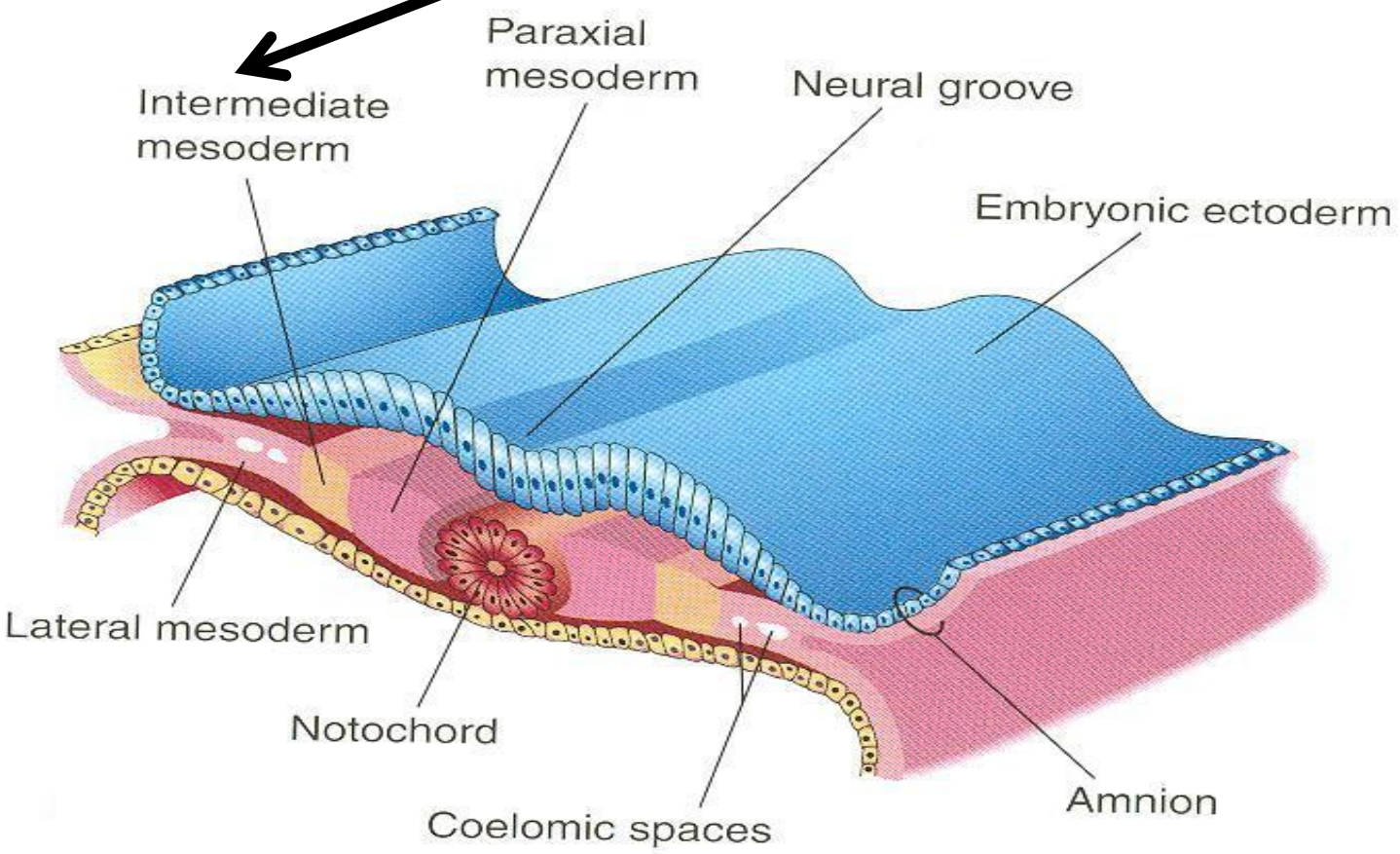
At the end of the lecture, students should be able to:

- 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.***

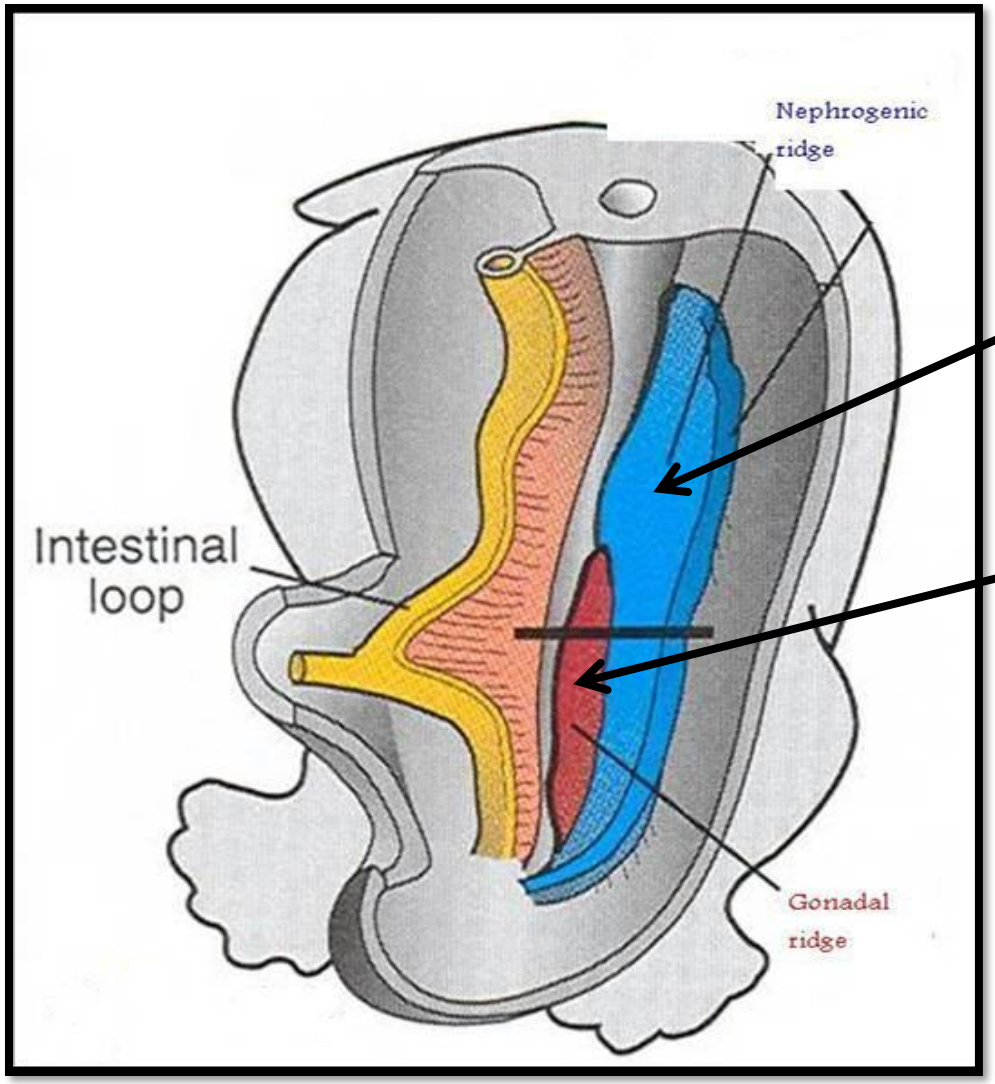
KIDNEYS & URETERS

EMBRYOLOGICAL ORIGIN

from



INTERMEDIATE MESODERM

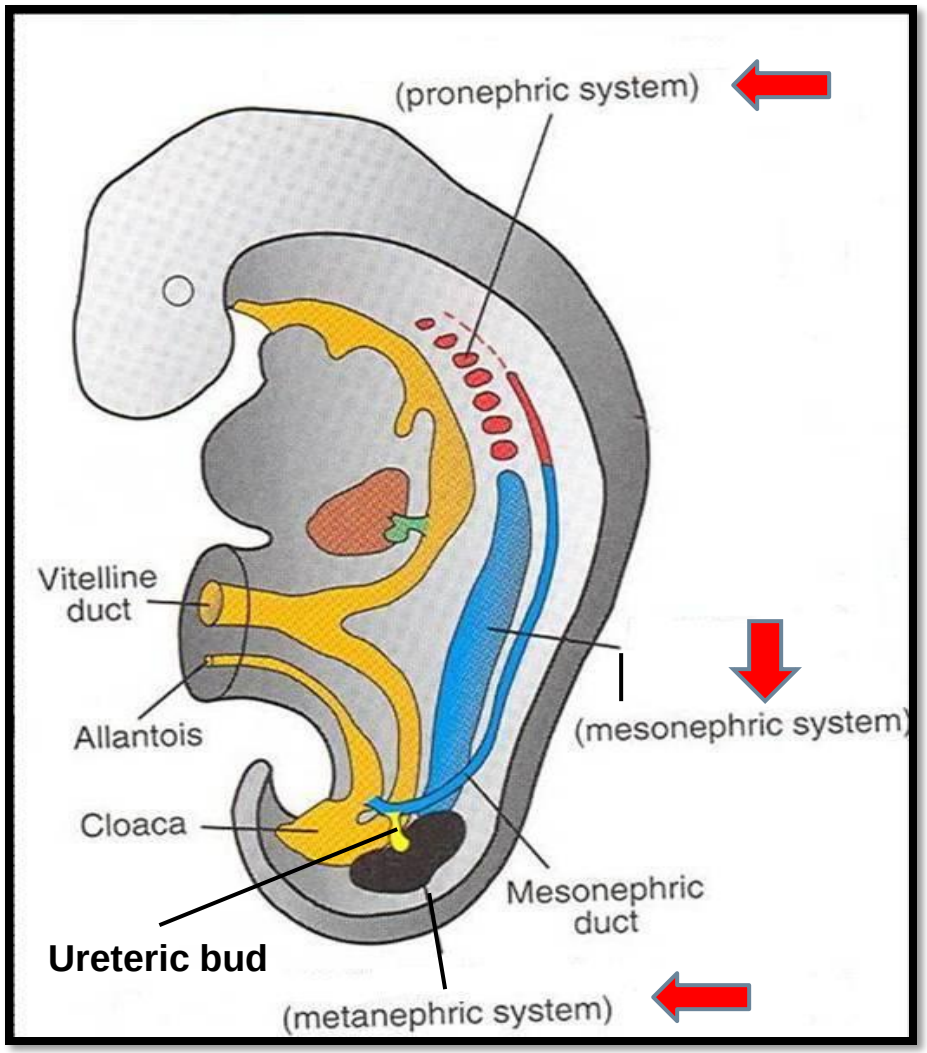


Divides into:

1. Nephrogenic ridge (cord): forms kidneys & ureters

2. Gonadal ridge: forms gonads (testes or ovaries)

DEVELOPMENT OF KIDNEYS



Three systems of kidneys develop:

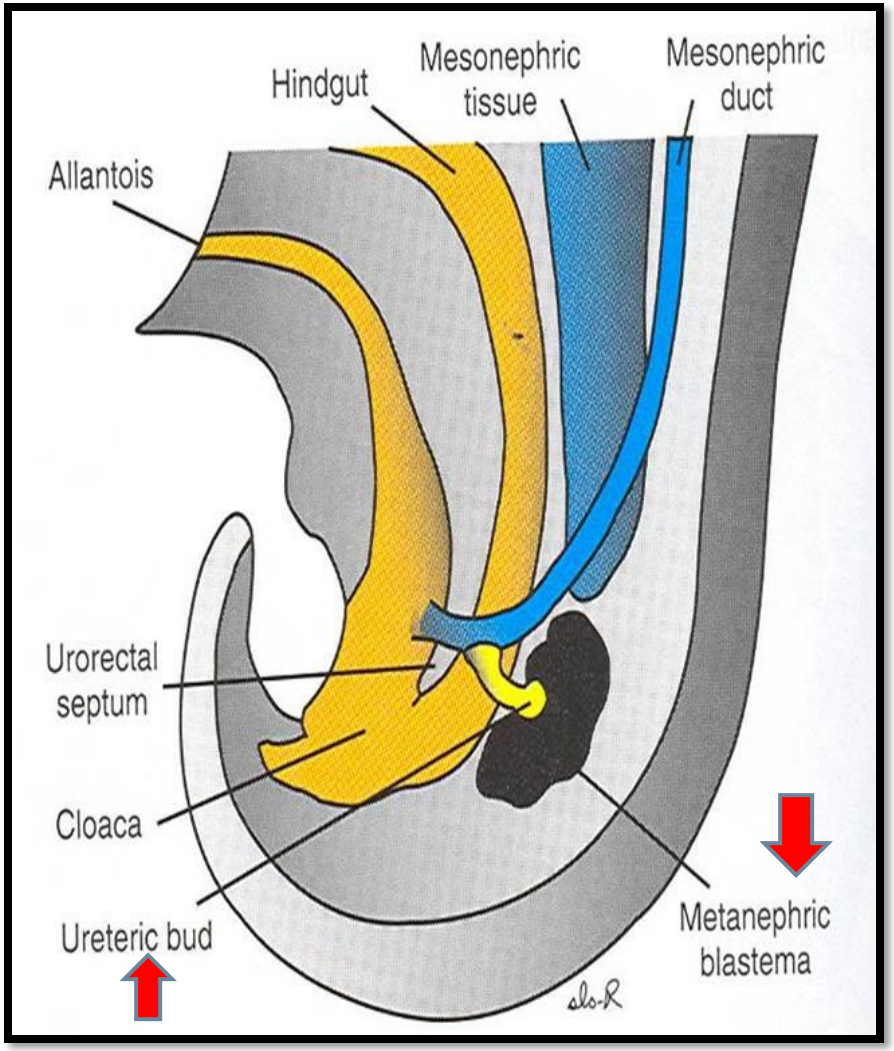
1. **Pronephric system:**
   - appears at beginning of 4th week in **cervical region**
   - analogous to kidney of fish
   - formed of tubules & a duct
   - not function in human
   - disappears
2. **Mesonephric system:**
   - appears at end of 4th week in **thoracic & abdominal regions**
   - analogous 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



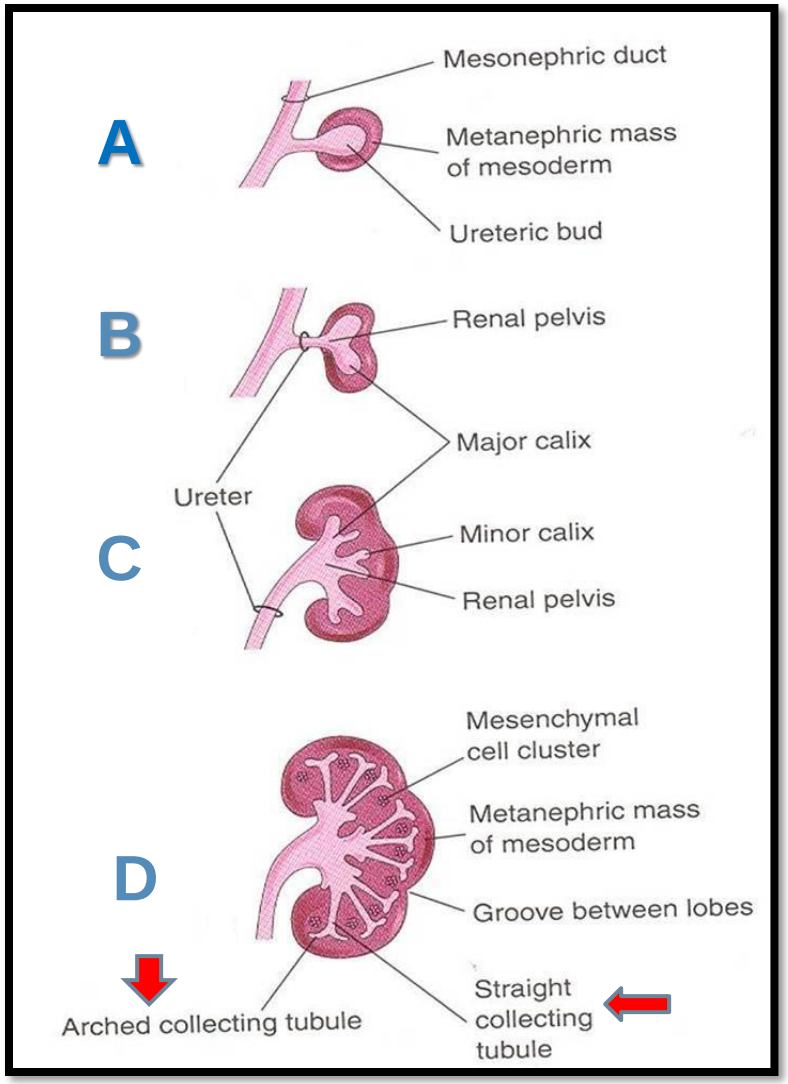
COLLECTING PART

A- Ureteric bud elongates & penetrates metanephric mass.

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

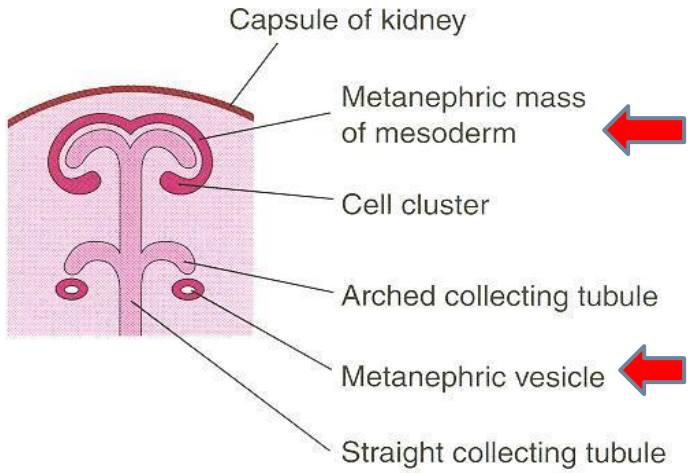
C- Branching of renal pelvis gives 3 major calices. Branching of major calyces gives minor calyces.

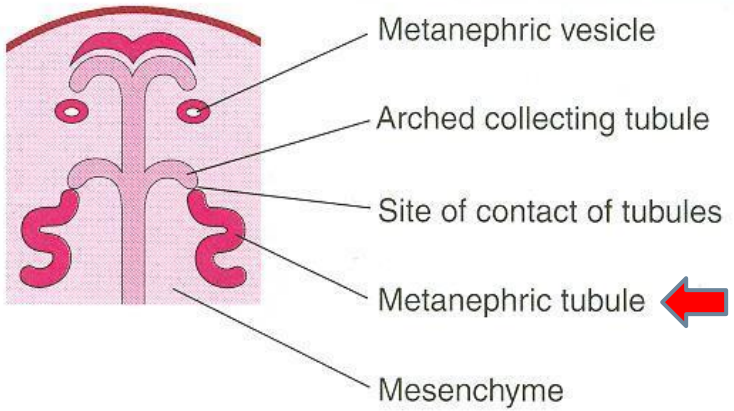
D- Continuous branching gives straight then arched collecting tubules



EXCRETORY PART

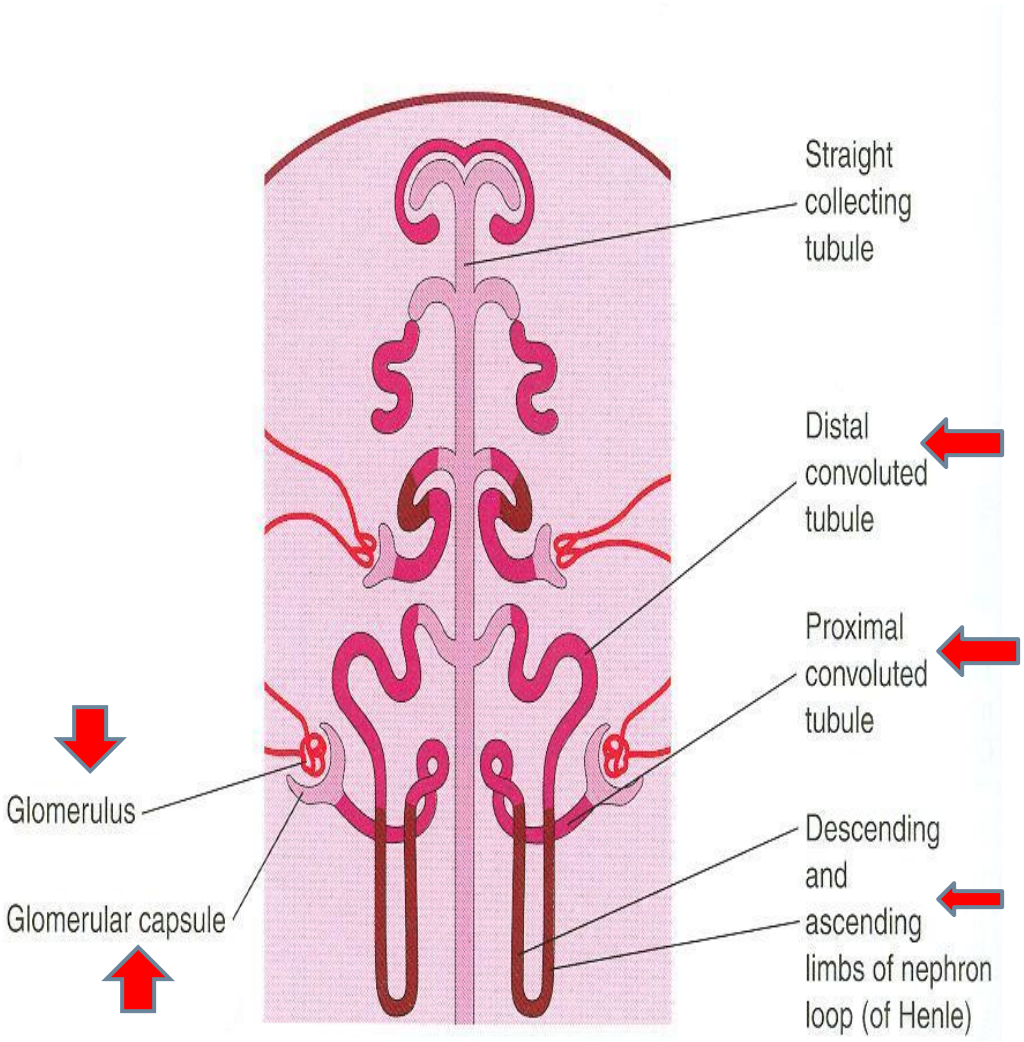
- Each arched collecting tubule is surrounded by a cap of metanephric mass.
- The metanephric cap forms the metanephric vesicle.
- The metanephric vesicle elongates to form an S-shaped metanephric tubule.





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**

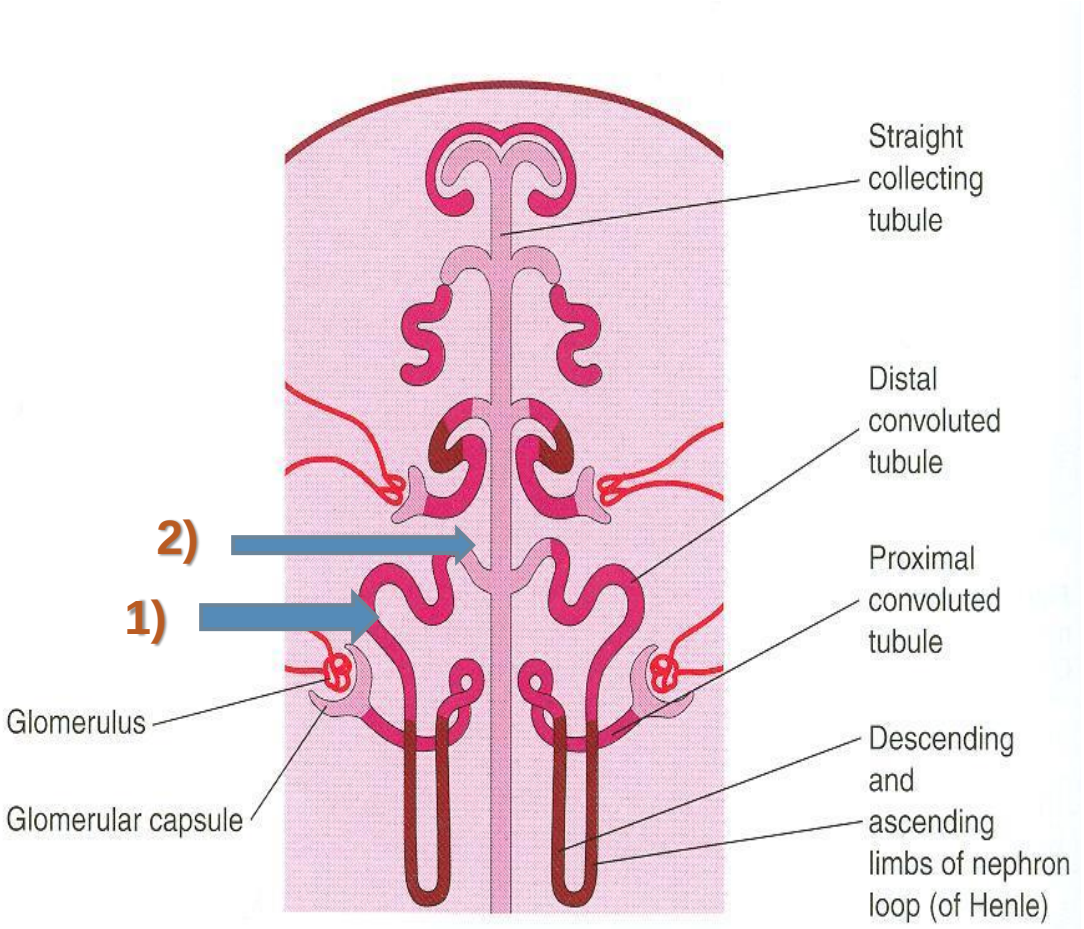


THE NEPHRON
FUNCTIONAL UNIT OF KIDNEY

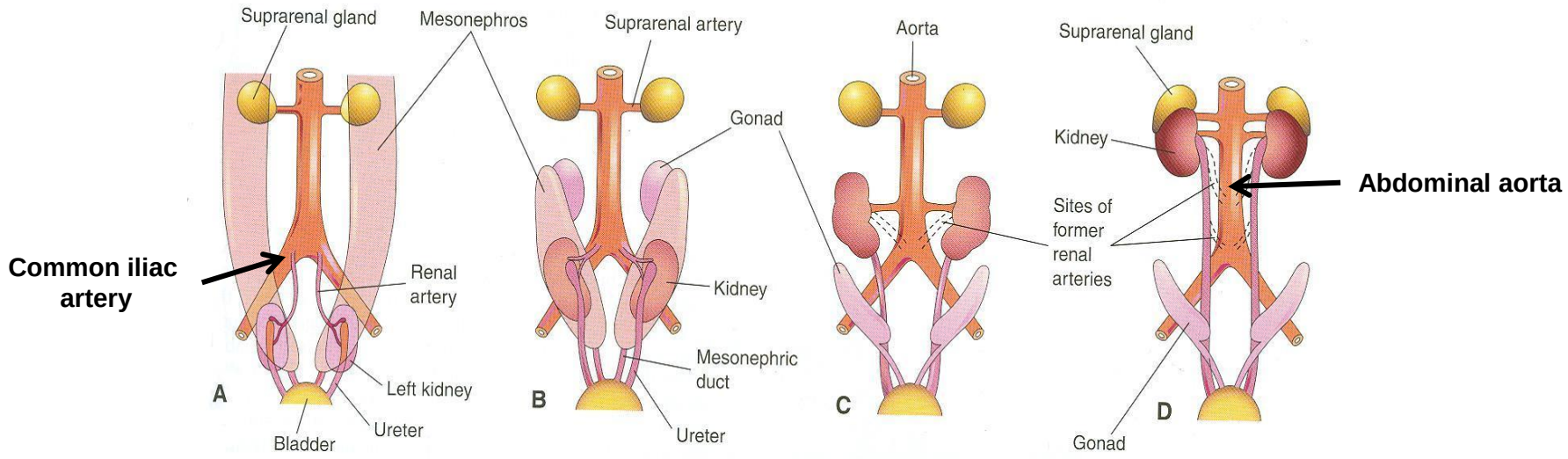
The nephron is formed by fusion of:

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)



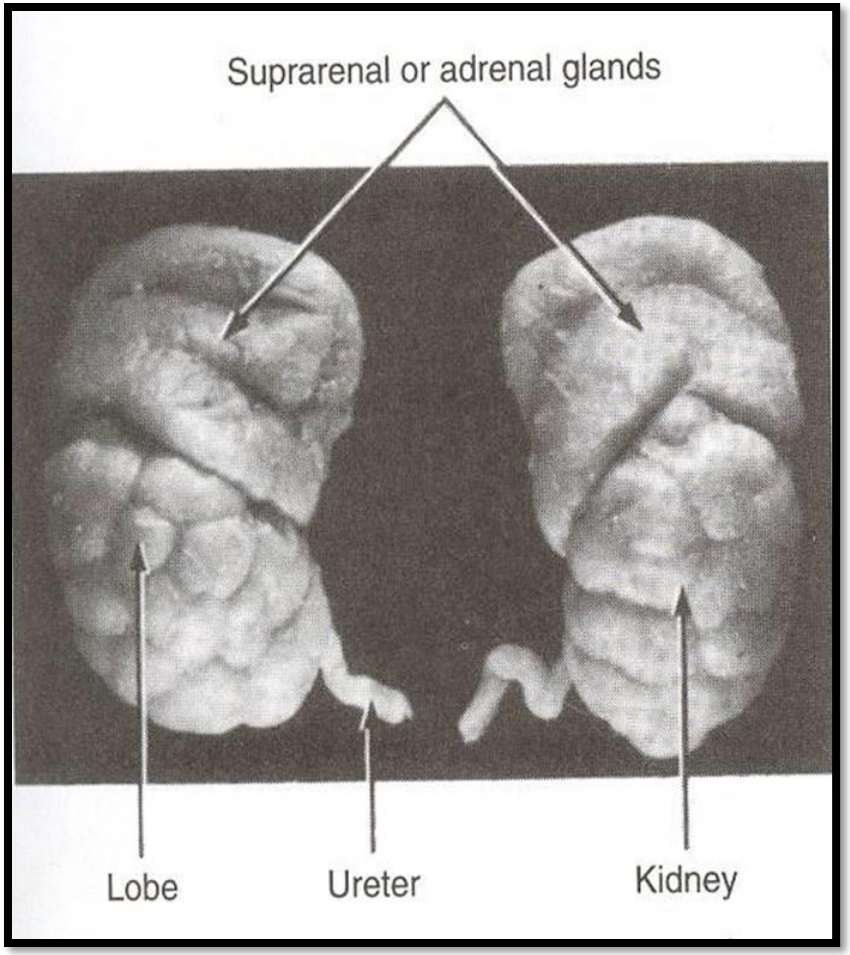
- **Change in position:** The kidney ascends from pelvis to abdomen & attains its adult position, **caudal to suprarenal gland.**

- **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 filatration **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.**



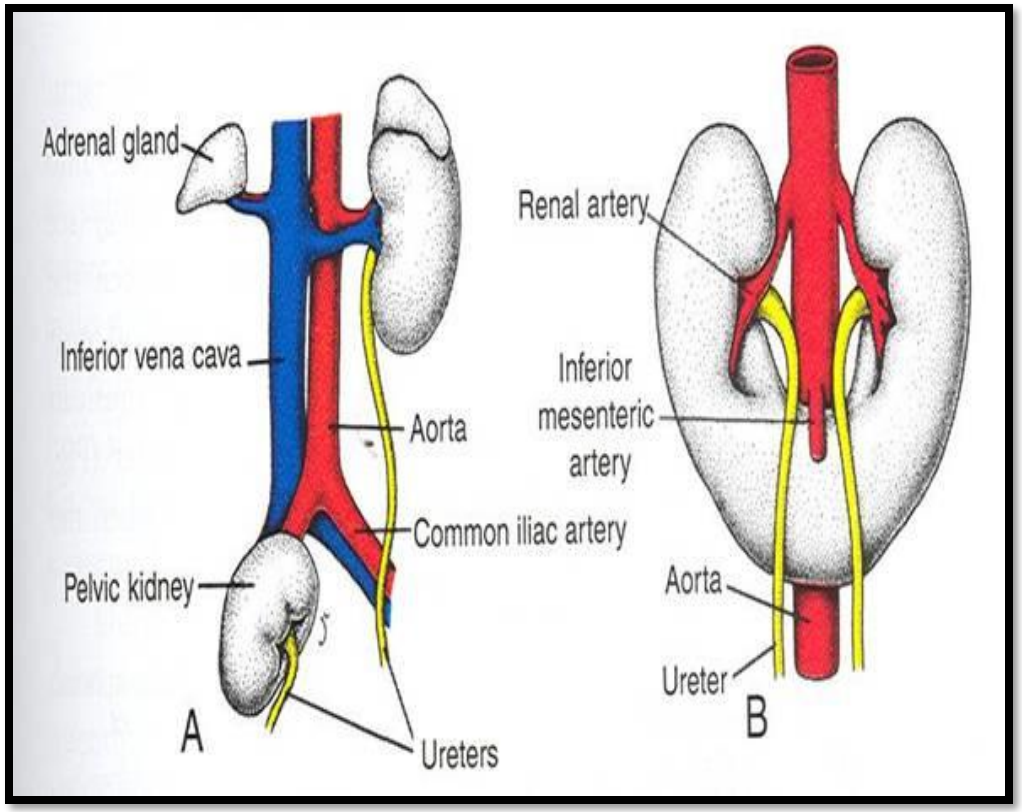
CHANGES AFTER BIRTH

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**

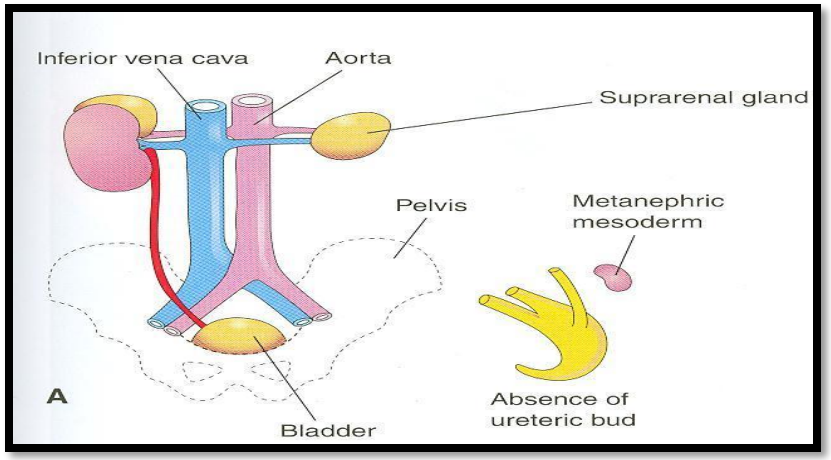
ANOMALIES

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

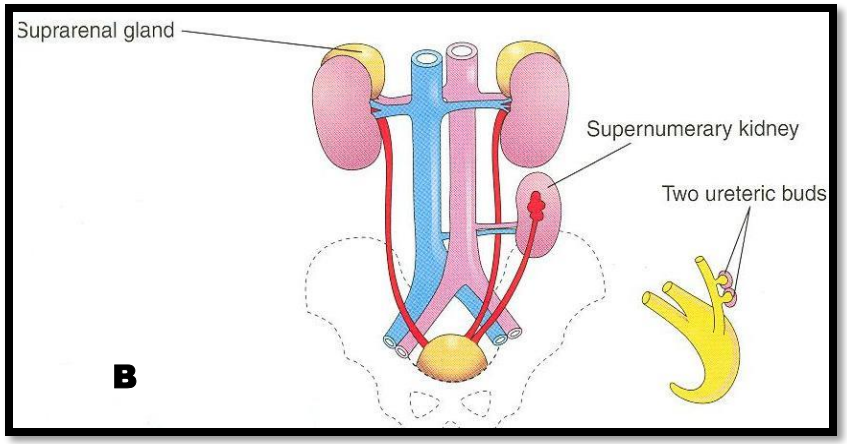
B. **Horseshoe kidney:** the poles of both kidneys (usually the **lower poles**) fuse: the kidneys have a lower position than normal but have normal function



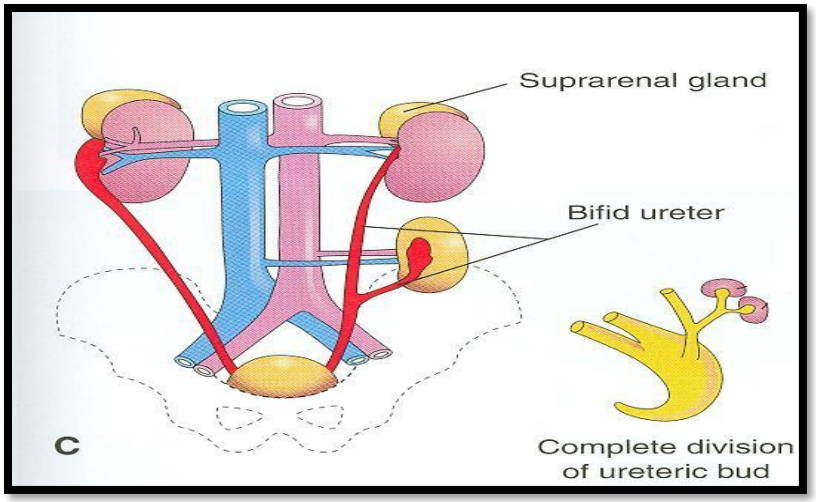
ANOMALIES



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