

# Embryology team 430

## 1<sup>st</sup> lecture

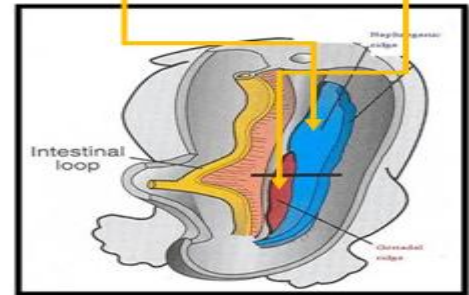
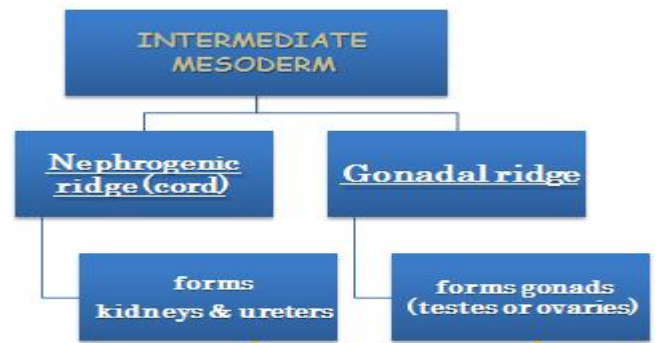
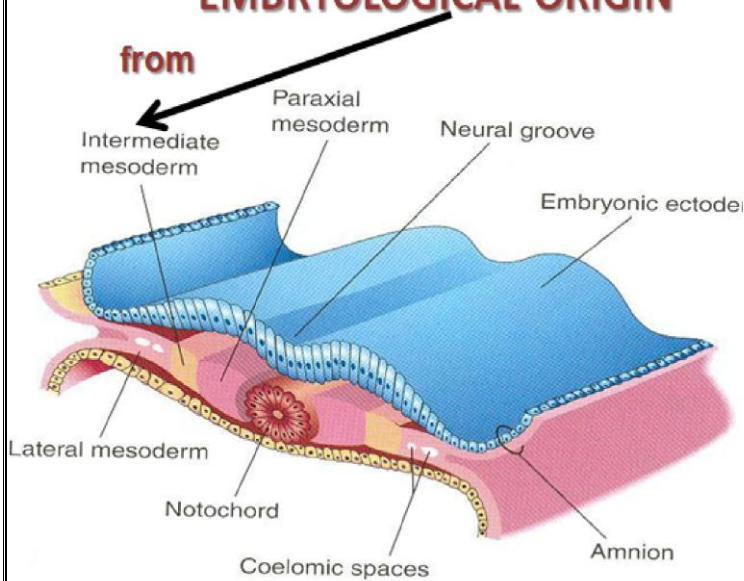
### DEVELOPMENT OF KIDNEYS & URETES

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# KIDNEYS & URETERS

## EMBRYOLOGICAL ORIGIN



## DEVELOPMENT OF KIDNEYS

### Three systems of kidneys develop

#### 1. Pronephric system

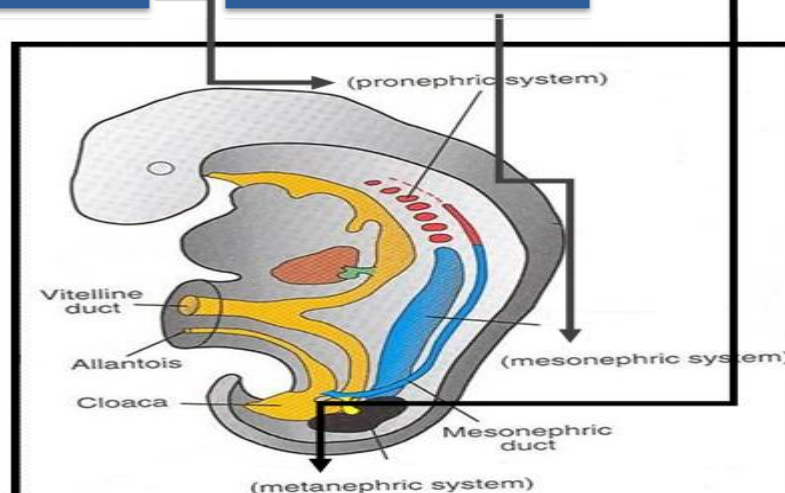
- \*appears at beginning of 4<sup>th</sup> week in cervical region
- \*analogous to kidney of fish
- \*formed of tubules & a duct
- \*not function in human - disappears

#### 2. Mesonephric system

- \*appears at end of 4<sup>th</sup> 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 5<sup>th</sup> week in pelvis
- \*starts to function at 9<sup>th</sup> week



Kidney has 2 functions:

- 1- Excretion
- 2- Collecting

\*that's why the mesonephric has

1) Ureteric bud (derived from mesonephric duct – before opening in the cloaca ): **gives collecting part of kidney**

2) Metanephric blastema (mass): **gives excretory part of kidney**

## COLLECTING PART

- Urethra in the kidney = ureter pelvic (renal pelvic )
- Ureter outside the kidney = ureter

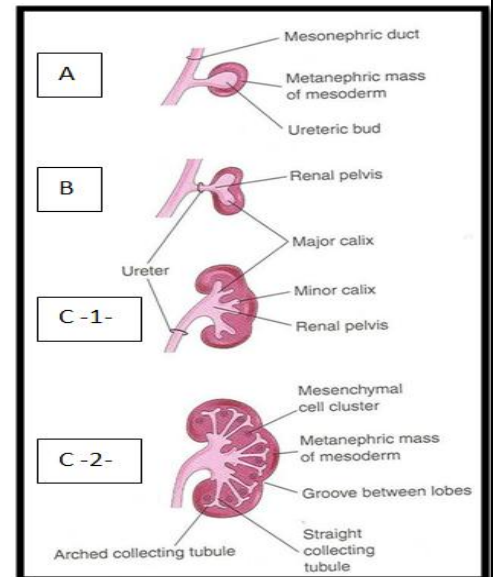
A. Ureteric bud elongates → penetrates metanephric mass.

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

C. -1- Branching of **renal pelvis** → 3 major calices

Branching of major calices → minor calices.

-2- Continuous branching → straight → arched collecting tubules



## EXCRETORY PART

Arched collecting tubule **surrounded by** cap of metanephric mass **Divided into**

Metanephric vesicles **Elongate & form** metanephric tubule ( **S-shaped** )

glomerular (Bowman's) capsule **Each tubule forms** **Lengthens & form** proximal & distal convoluted tubules + loop of Henle

Each glomerular capsule is invaginated ;(folding inside) by capillaries (glomerulus).

The nephron is formed by fusion of:

Excretory tubule formed of metanephric mass (cap).

Arched collecting tubule formed of ureteric bud.

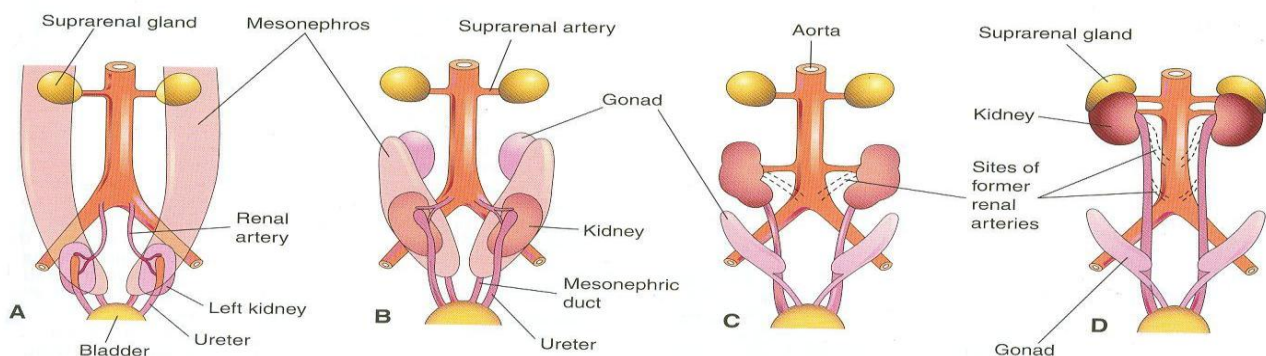
\*At full term, each kidney contains: 800000 – 1000000 nephrons.

## CHANGES DURING DEVELOPMENT (BY 9<sup>TH</sup> 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.



Position: till it reach the suprarenal gland.

Blood supply: into renal branches of abdominal aorta.

Rotation: rotates medially about 90° & becomes medial.

### THE FETAL KIDNEY

At 9<sup>th</sup> week,

- Formation of Glomerular filtration.
- 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.

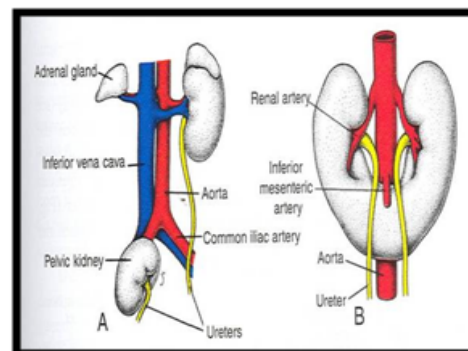
### CHANGES AFTER BIRTH

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)

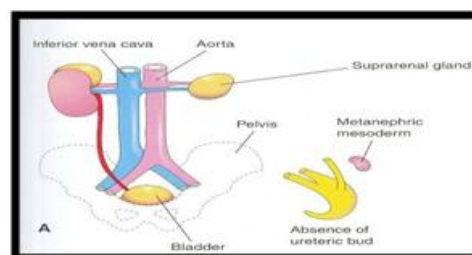


B. **Horseshoe kidney**: the poles of both kidneys (usually the lower poles) fuse. The kidneys have a lower position than normal but have normal function

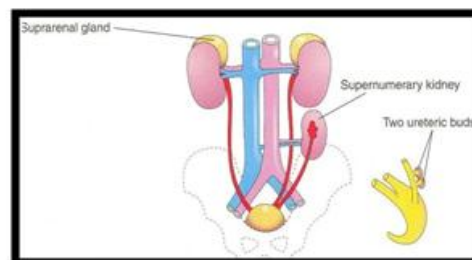
(تبقى الكليتين في مستوى أقل من الطبيعي لأن inferior mesenteric artery يدخل بينهما ويمنعهما من الصعود)

C. **Unilateral renal agenesis**: due to absence of one ureteric bud

(في هذه الحالة يكون ureteric bud ليس موجود لكن في الحالة الأولى يكون ureter موجود لكن قصير)



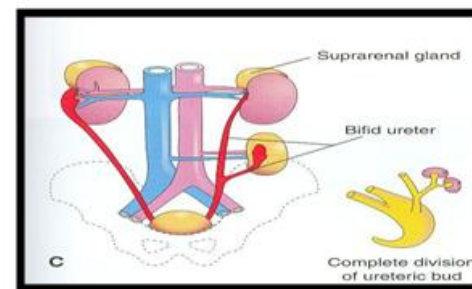
D. **Supernumerary kidney**: due to development of 2 ureteric buds.



E. **Right side: malrotation of kidney** (يعني خطأ في دوران الكلية)

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

(يصير فيه انشقاق ويصبح في كليتين)



## SUMMARY

- Kidneys & ureters originates from **nephrogenic ridge (cord)** of intermediate mesoderm.
- During development, 3 systems appear:
  - Pronephric**: in cervical region, not function.
  - Mesonephric**: in thorax & abdomen, function temporarily, mesonephric duct gives ureteric bud.
  - Metanephric**: in pelvis, permanent kidney.
- 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 9<sup>th</sup> week:
  - Glomerular filtration begins.
  - Kidney attains its adult position.
  - Kidney receives its arterial supply from aorta.
  - Kidney completes rotation.

□ **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.**

## QUESTION 1

□ Which one of the following events happens by 9<sup>th</sup> 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 metanephric mass?

- 1) Ureter
- 2) Collecting tubule
- 3) Glomerulus
- 4) Proximal convoluted tubule ←

Good luck 😊