أهلا وسهلا

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Development of kidney and ureter

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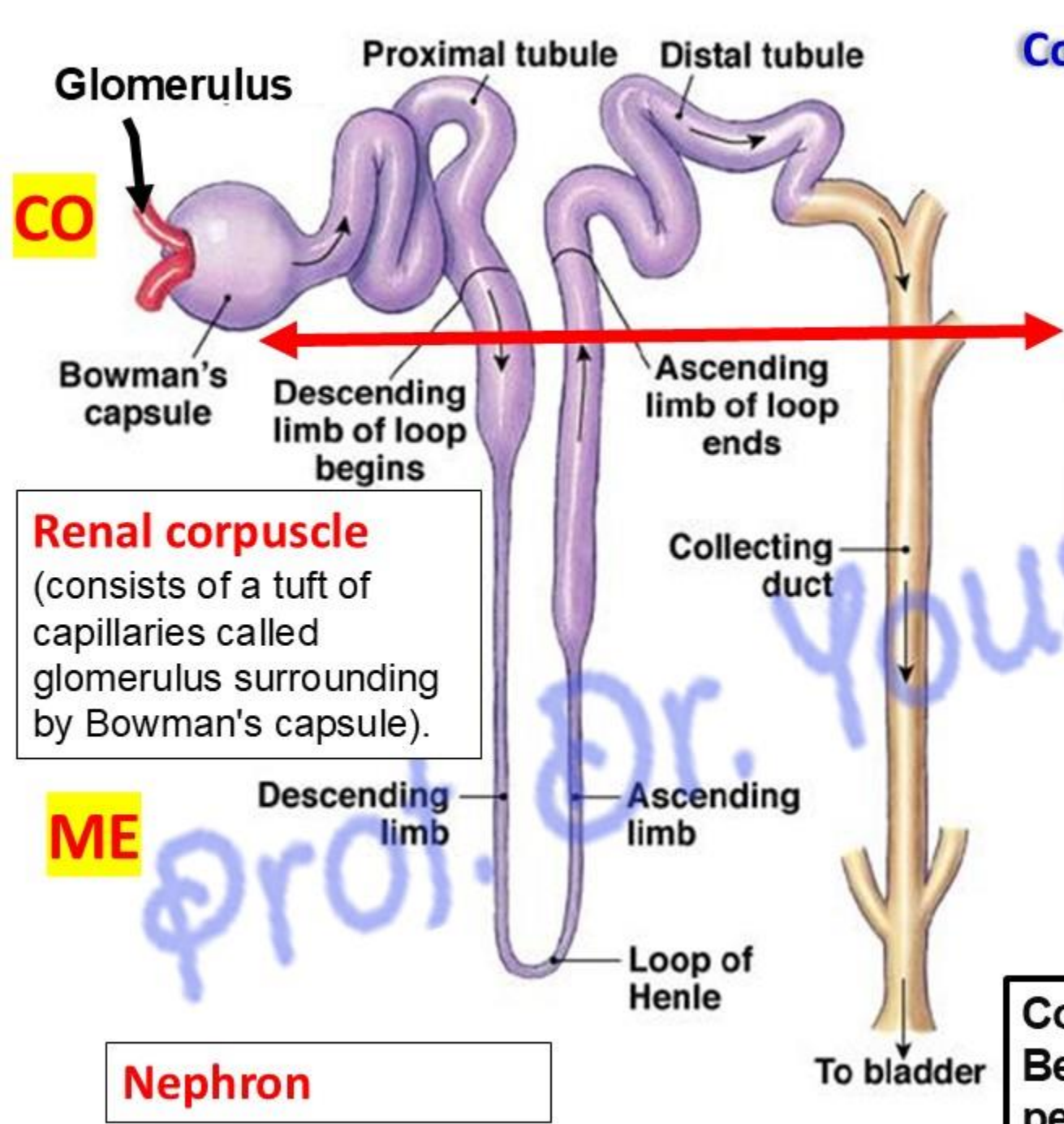
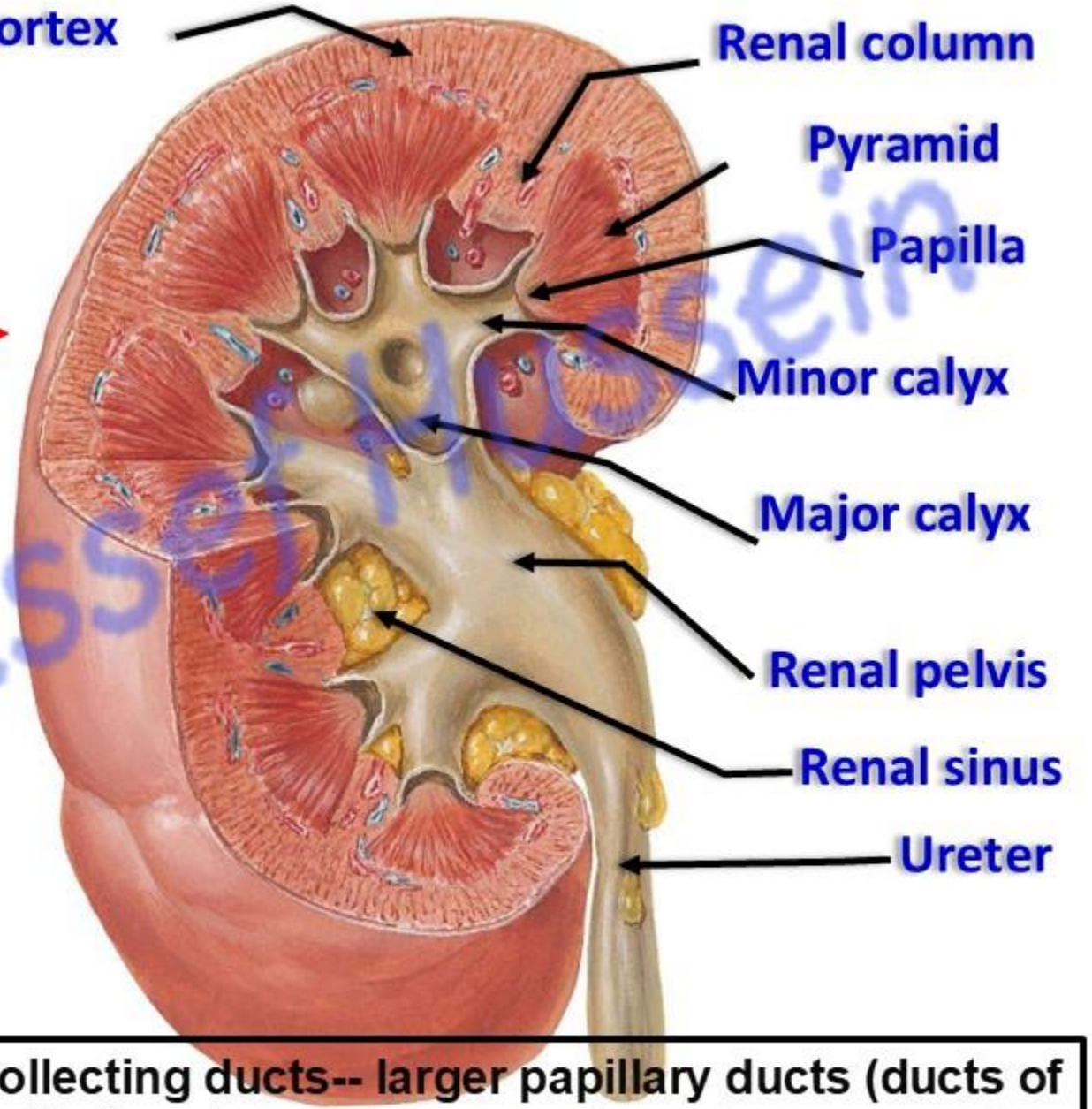
- The kidneys developed from the **intermediate mesoderm** (urogenital mesoderm).
- The kidneys pass into **3 successive stages** of development (overlap each other)



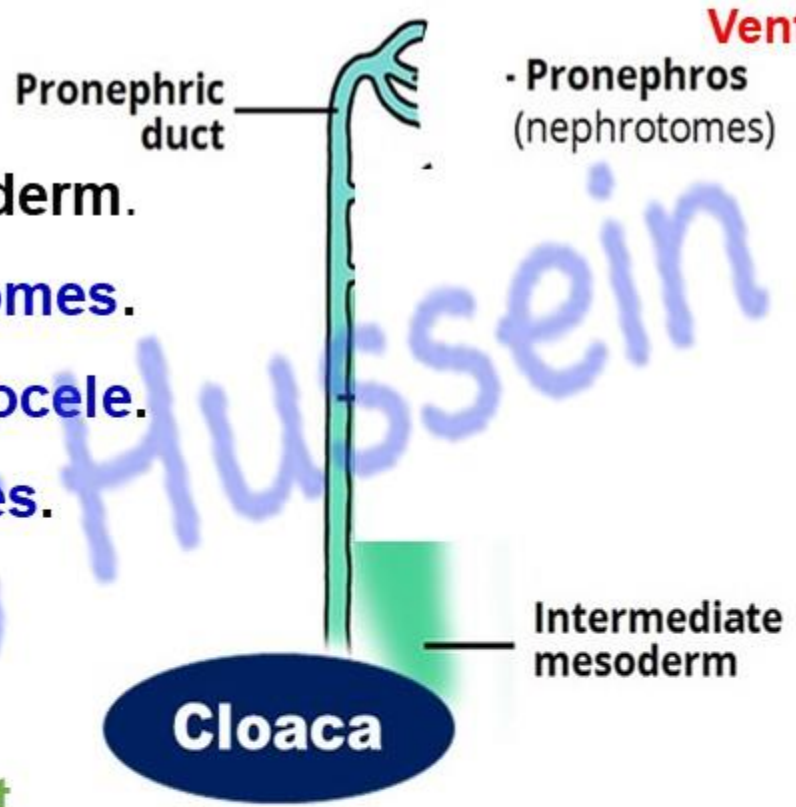
Renal corpuscle
(consists of a tuft of capillaries called glomerulus surrounding by Bowman's capsule).

Nephron



Collecting ducts-- larger papillary ducts (ducts of Bellini) --minor calyces --major calyces -- renal pelvis--- ureter

The first stage {Pronephros)



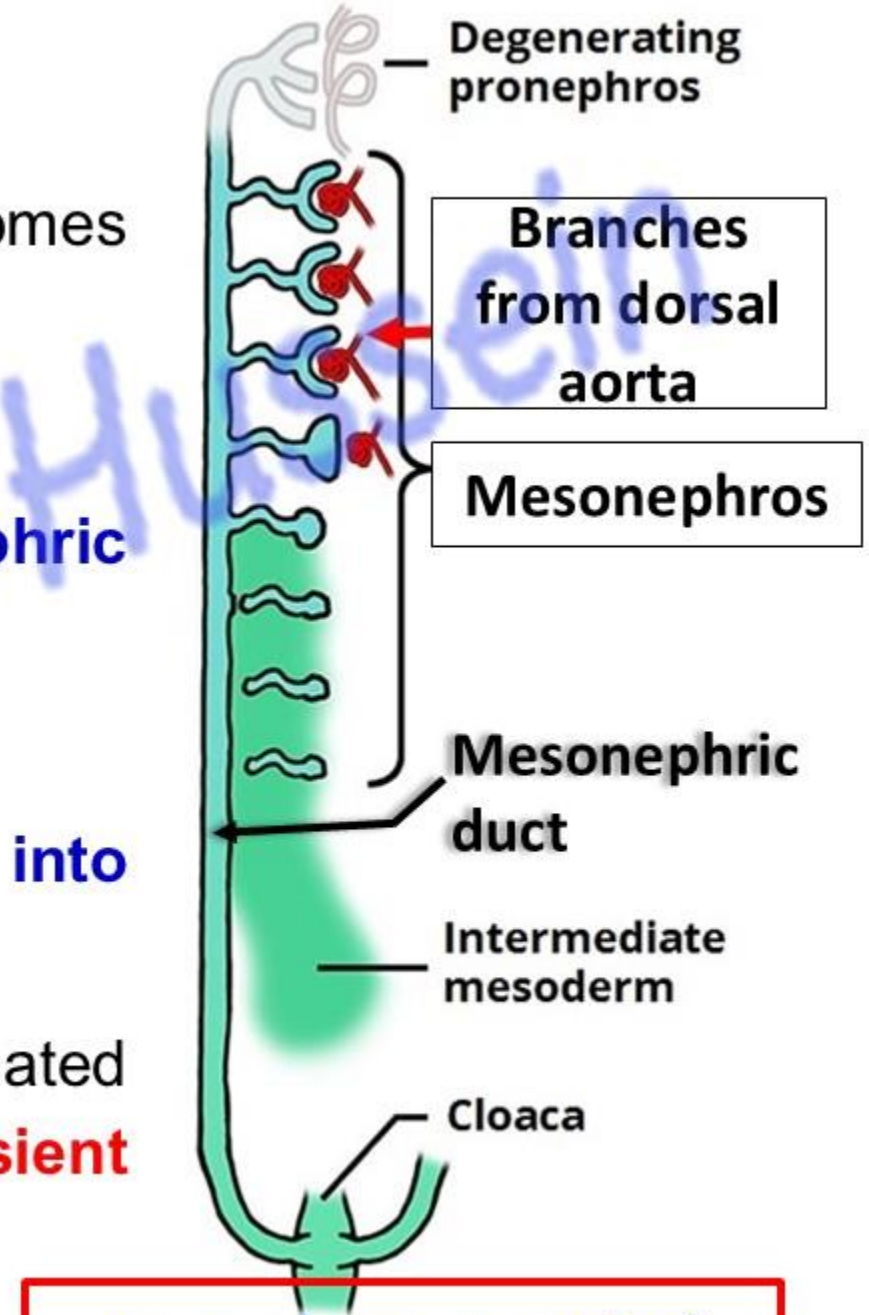
- It develops from the **cranial part** of the **intermediate mesoderm**.
- It is divided into 7 or 8 mesodermal masses called **nephrotomes**.
- Each nephrotome gets a small cavity changing it into **nephrocele**.
- The nephroceles elongated and form the **pronephric tubules**.
- **Each tubule has dorsal and ventral ends.**

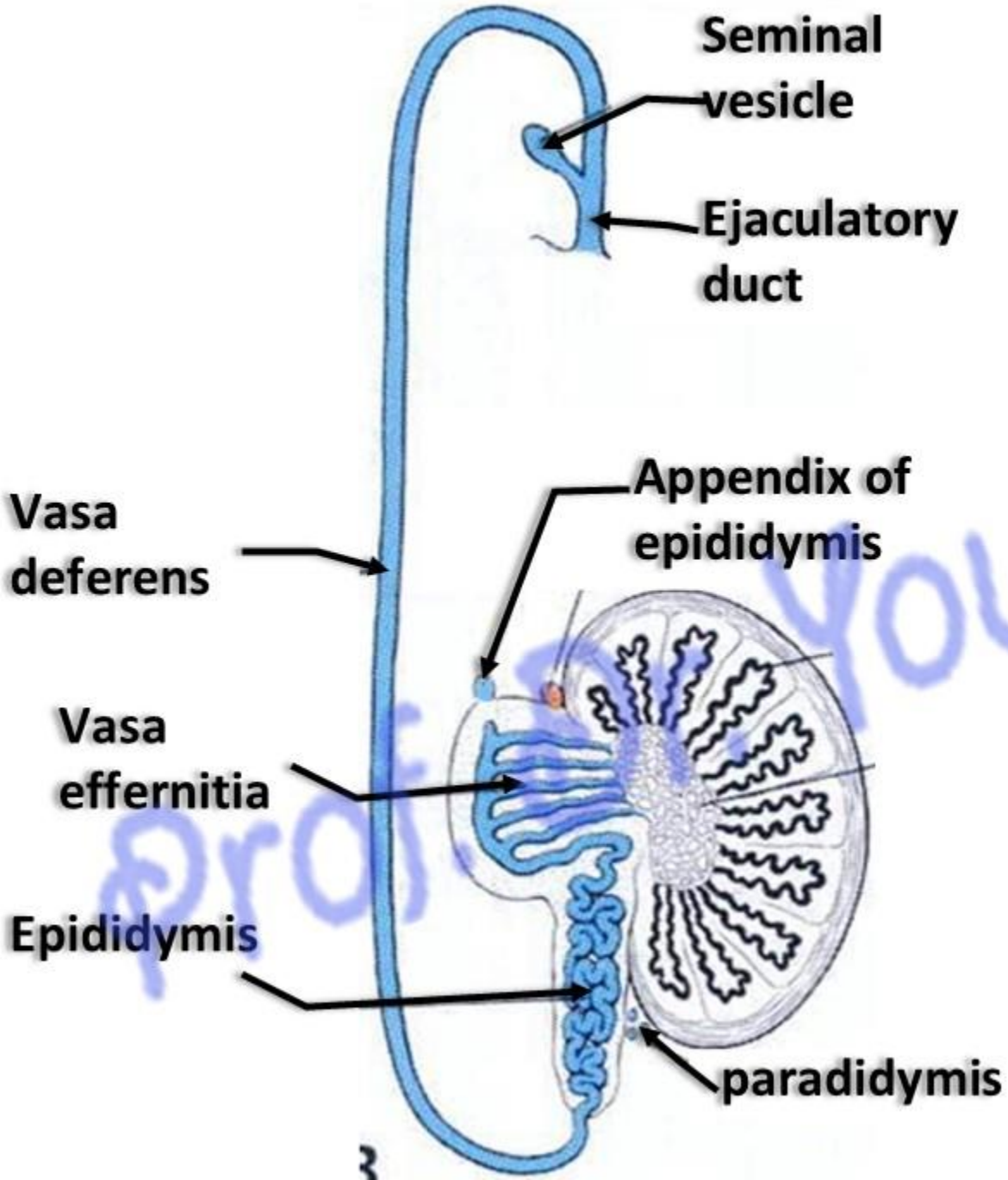
1) **Ventral ends** open into the **intraembryonic coelom**.
2) **Dorsal ends** join each other forming the **pronephric Duct**.

- The pronephric duct elongates caudally and opens into the **cloaca**.
- ** **Function,** it has **no excretory** function (**no glomeruli**).
- ** **Fate of pronephros:**
  - 1- The pronephric **tubules**: **disappear** completely
  - 2- The pronephric **duct**: remain to be used as a **mesonephric duct**.

- **Second stage**
- **{Mesonophros} (WOLLFIAN)**

- The middle part of the **intermediate** mesoderm becomes segmented into 70-80 masses called **nephrotomes**.
- There is a small cavity transforming it to **nephrocele**.
- Each nephrocele elongates forming **S-shape mesonephric tubule**.
- Each tubule has ventral and dorsal ends.
  - **a- Dorsal end** of each mesonephric tubule **opens into mesonephric duct.**
  - **b- Ventral end** of each tubule enlarged and invaginated by a branch from **dorsal aorta** forming a **transient glomerulus.**
- **So; the mesonephros has an excretory function.**





** Fate (derivatives) of mesonephros

- By the end of **the 5th week** of development shows the following changes:

- In male embryo:

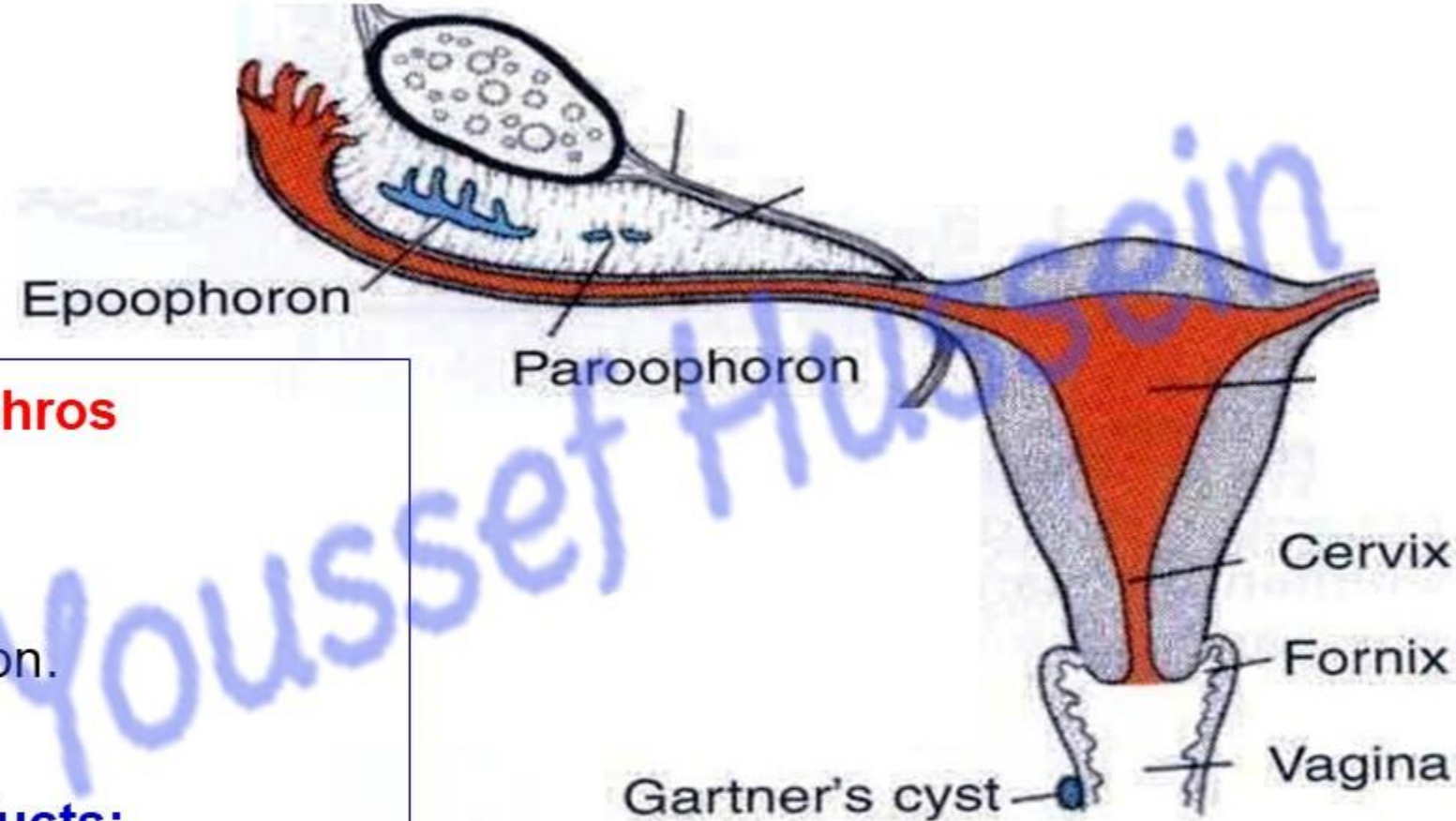
1- Mesonephric tubules:

- **Cranial part** forms appendix of **E**pididymis.
- **Middle part** will form vasa efferentia.
- **Caudal part** forms **P**aradidymis.

2- Mesonephric (Wolffian) duct:

- It forms epididymis, vas deferens, seminal vesicle and ejaculatory duct.

- Trigone of urinary bladder
- Ureteric bud



** **Fate (derivatives) of mesonephros**

- In female embryo:

1- The mesonephric tubules:

- **Cranial part** forms the **E**poophron.
- **Caudal part** forms **P**aroophron.

2- The mesonephric (Wolffian) ducts:

- Gartner's cyst in the vaginal wall.
- Trigone of urinary bladder
- Ureteric bud

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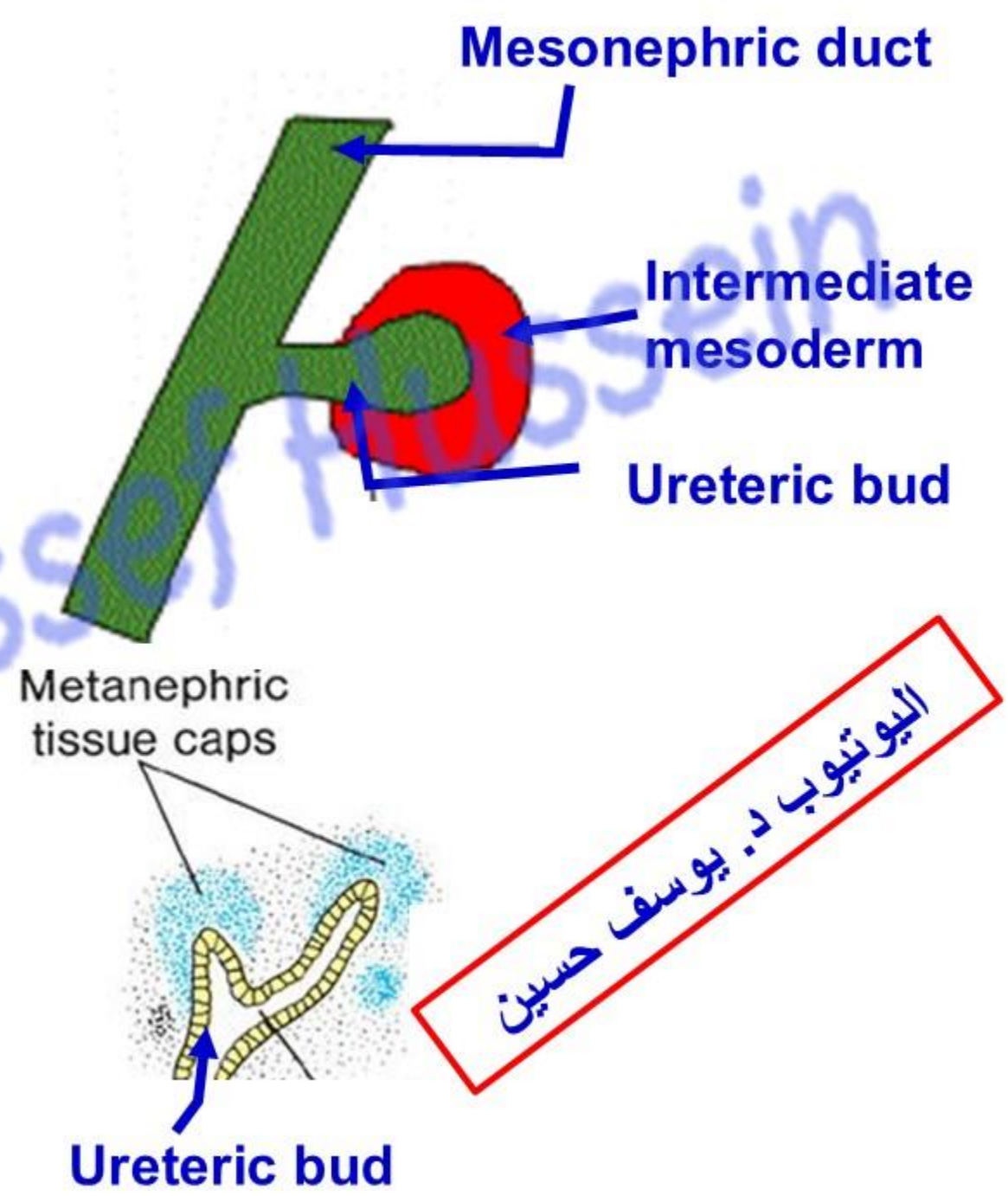
- **Third stage**

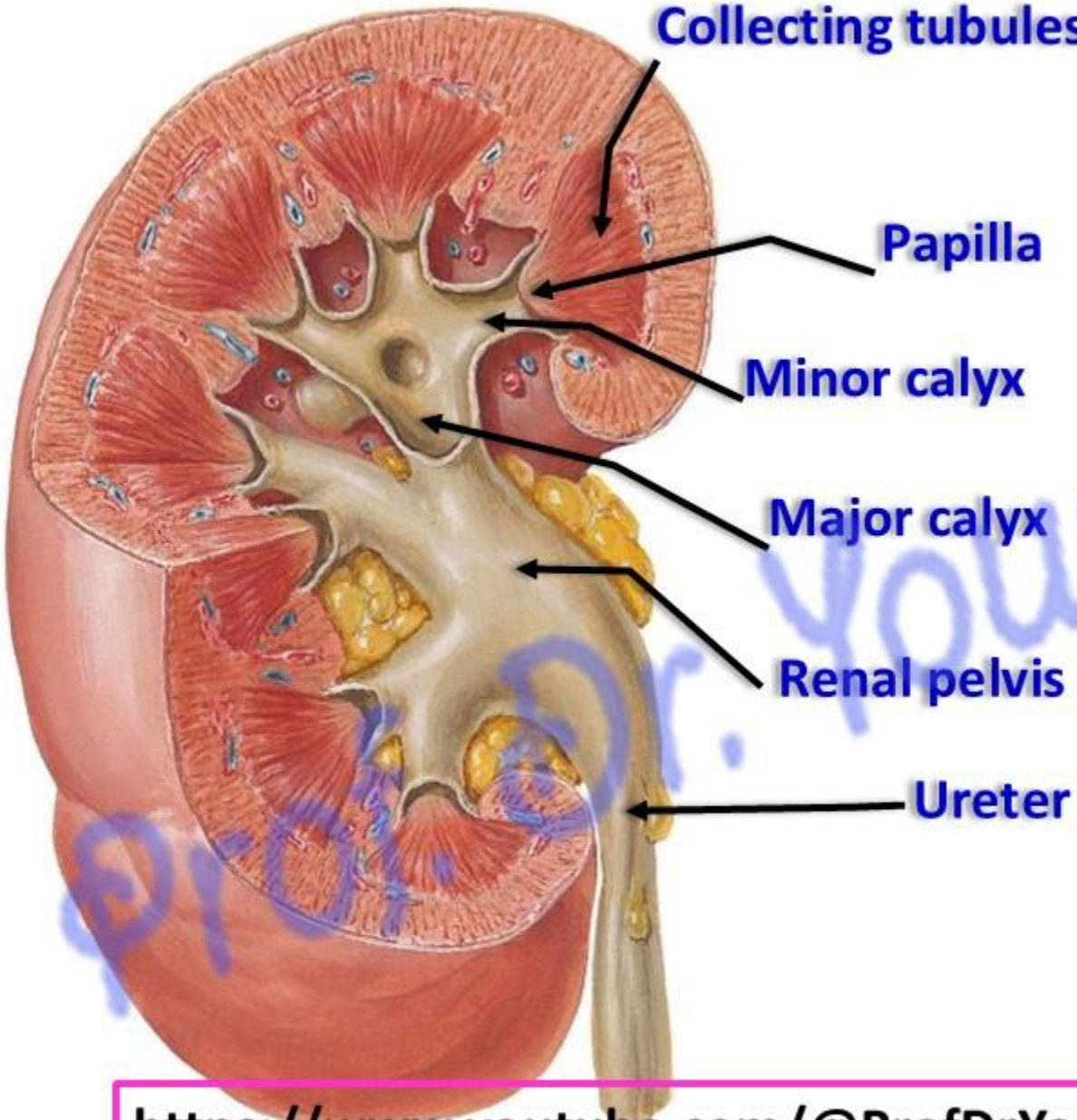
(The Metanephros, Permanent Kidney)

* Before the disappearance of mesonephros (**by the 5th week**), the metanephros starts its development:

a- Ureteric bud from mesonephric duct.

b) This bud grows **upward and backward** till invading caudal part of **intermediate mesoderm that called metanephric cap or blastema (opposite the lower lumbar and sacral somites).**





The ureteric bud gives ureter--- renal pelvis… major calyces----- minor calyces ----- papillae ------ collecting tubules

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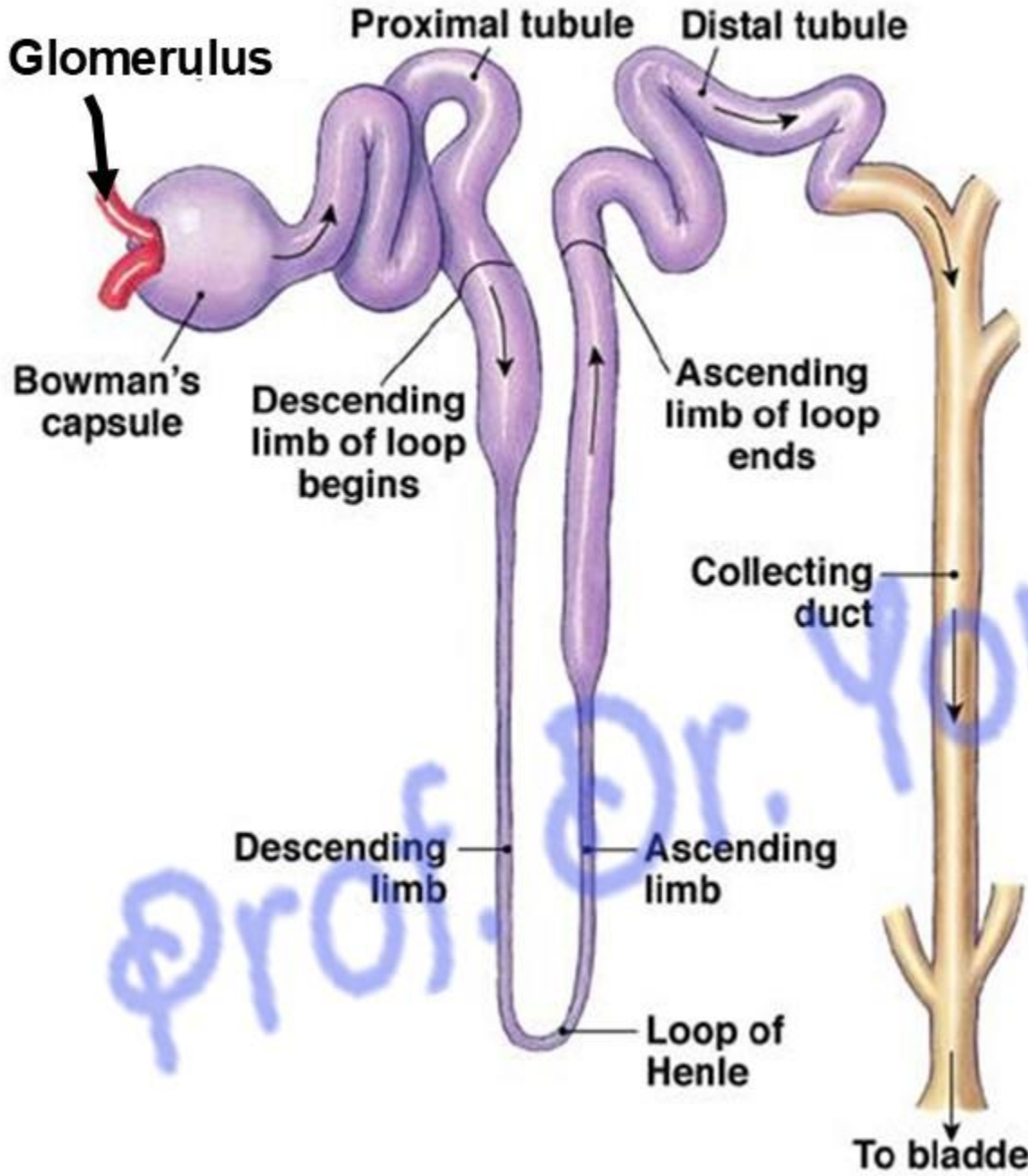

- Changes in the metanephric cap (blastema)

* **Dorsal end** lies in contact with collecting tubule but **without canalization**.
* **Ventral end** invaginated by branch from **internal iliac artery** forming glomerulus surrounded by Bowman's capsule.

- This tubule will elongate forming proximal convoluted tubules, loop of Henle and distal convoluted tubule.
- **Later on distal convoluted tubule will be canalized with the collecting tubule.**

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Post-developmental changes of the kidneys

1. **Change in surface**; disappear of the fetal lobulation by the capsule.
2. **Change in position**; ascend upward to the lumbar region.
3. **Medial rotation 90 degree,** Hilum becomes medially after rotation.
4. **Change in blood supply**;

    a) In the **pelvis**, it is supplied from the **internal iliac artery**.

    b) During its ascent, it is supplied by the **common iliac artery**.

    c) At its normal position, it is supplied by the **abdominal aorta**.

- the definitive nephrons (metanephros) begin to produce urine and secrete it into the amniotic fluid during the first trimester (around weeks 11–13), with this production increasing significantly throughout the **second half of pregnancy**

Congenital anomalies of kidney and ureter

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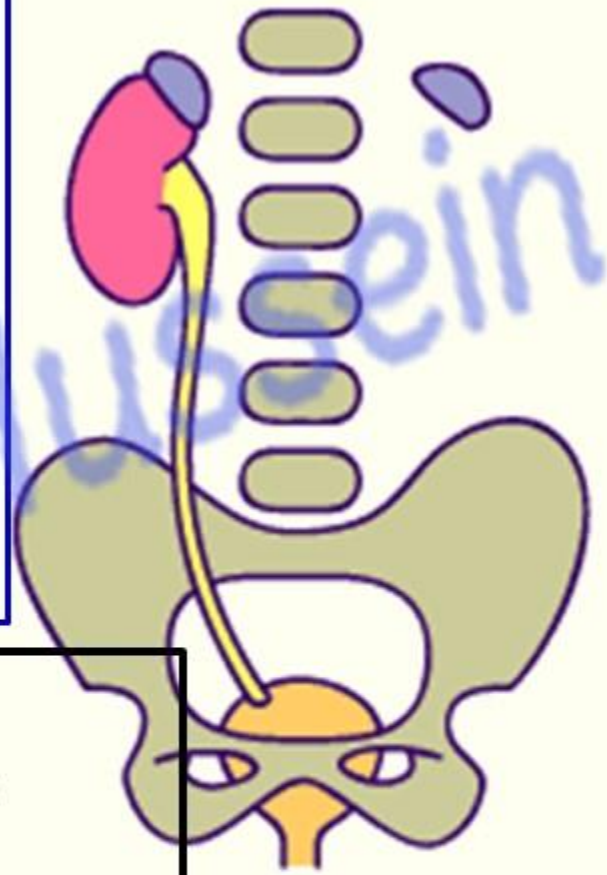
❖ Agenesis

- **Causes**:

1- Failure of development of the **ureteric bud** (no ureter and kidney).

2- **Failure of contact** of the ureteric bud and intermediate mesoderm (ureter and no kidney).



- **It may be**
- **Unilateral agenesis**, It may be not noticed until problems occur in the solitary kidney.
- **Bilateral agenesis** the amount of amniotic fluid decreased (oligohydramnios) and the fetus die within few days after birth.

• **Renal hypoplasia:** Kidneys are structurally normal but too small, resulting in reduced nephron count.

- **Persistence fetal lobulation on external surface**

❖ Abnormalities of surface

- **Polycystic kidney:** due to **failure of canalization** between distal convoluted tubules and collecting tubules.

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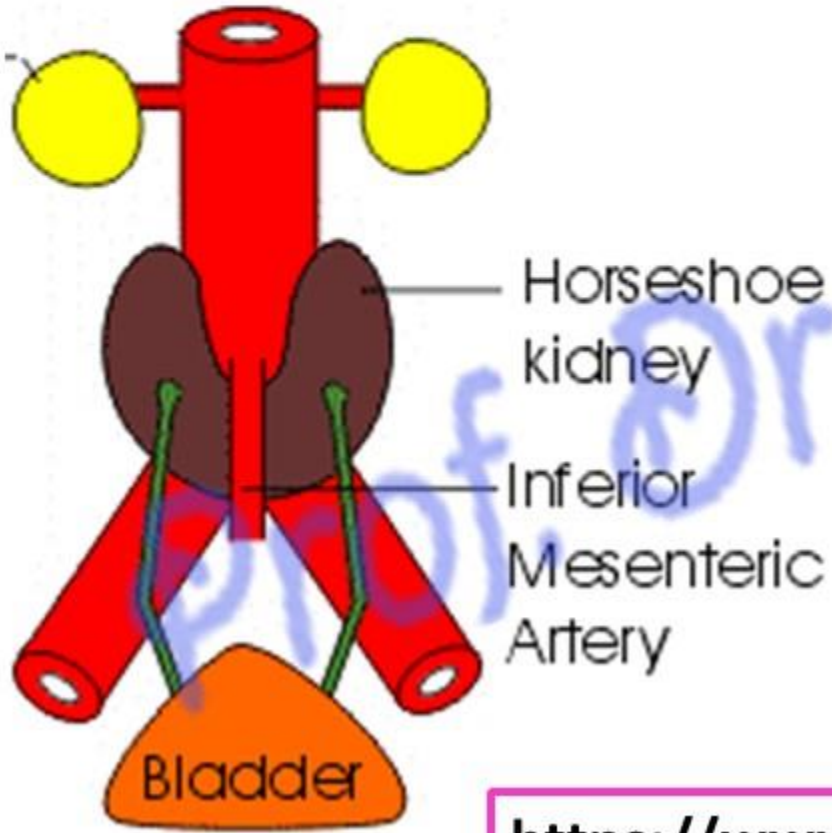
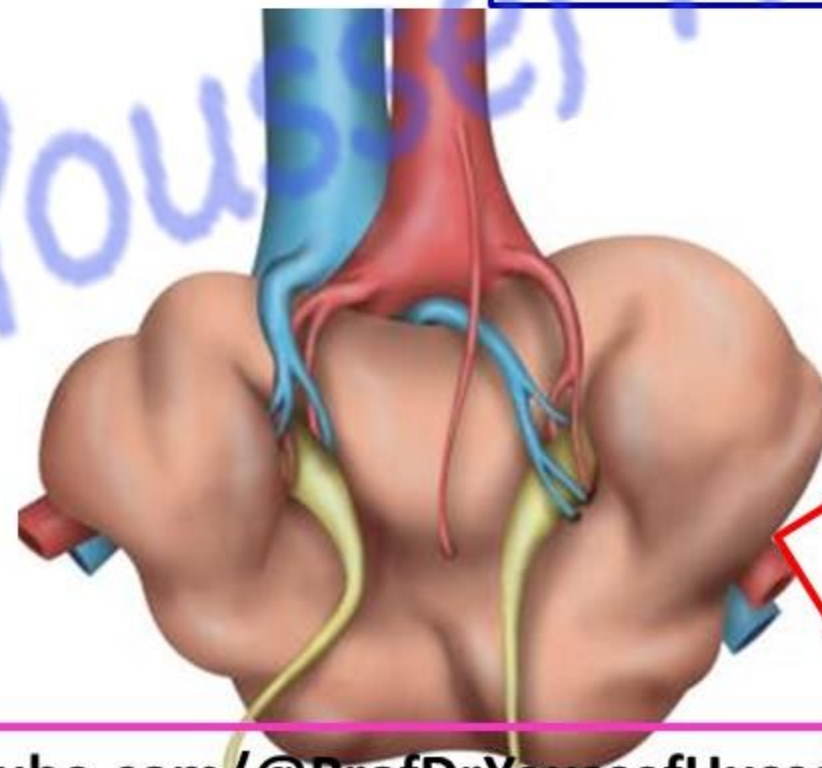
❖ Abnormalities of shape

- **Horseshoe kidney** due to fusion of the lower poles of both kidneys.

  - It lies in lower abdominal cavity because its ascent is prevented by inferior mesenteric artery.

- **Rosette (cake) shaped kidney**:
  - due to fusion of both upper and lower poles of two kidneys.
  - They remain in the pelvis.





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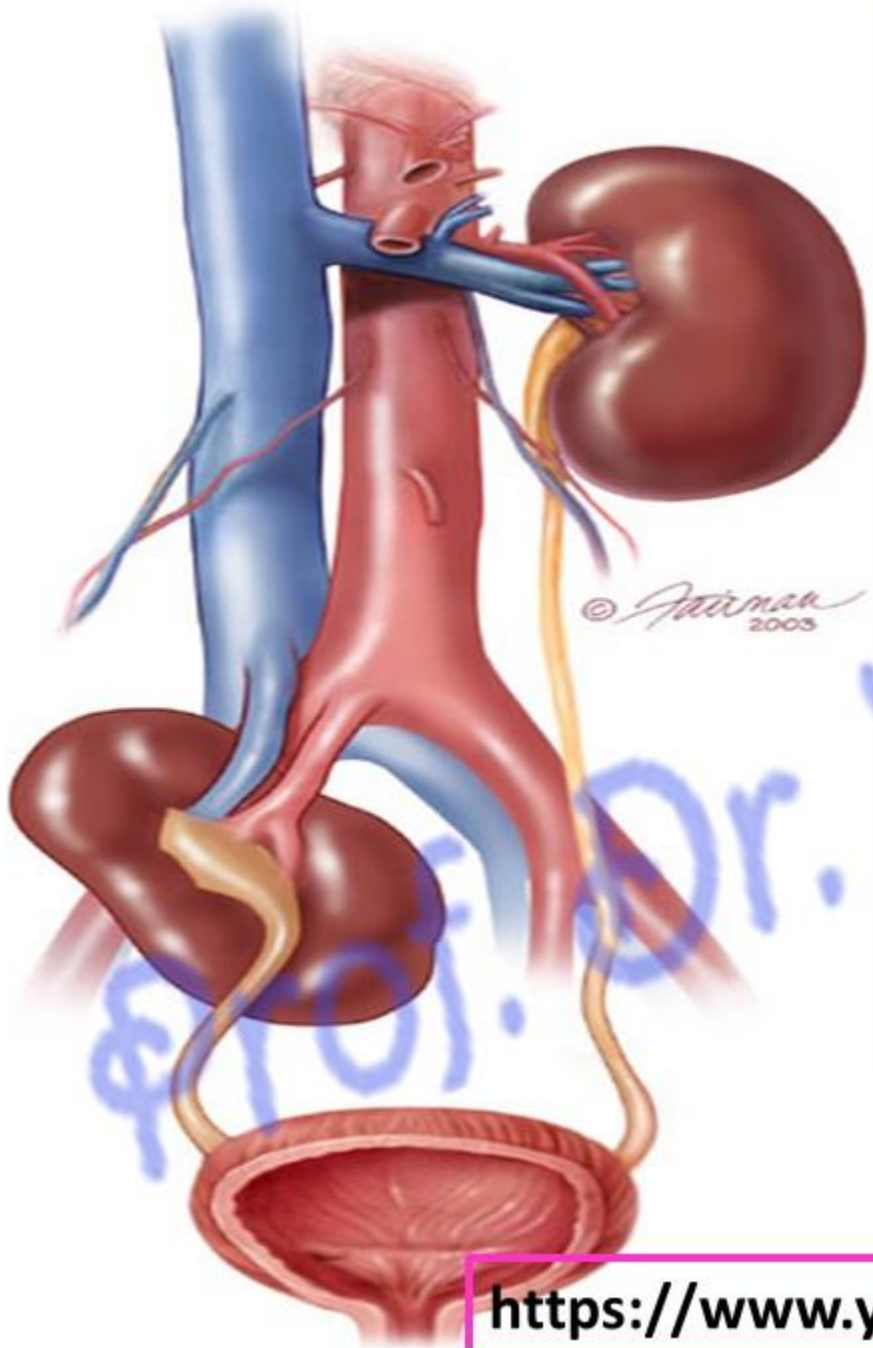


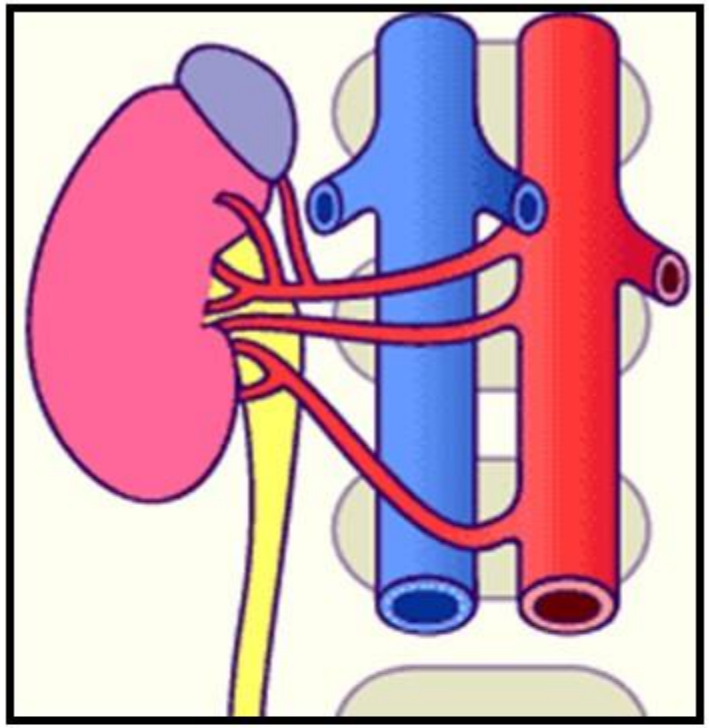
❖ Abnormalities of the position

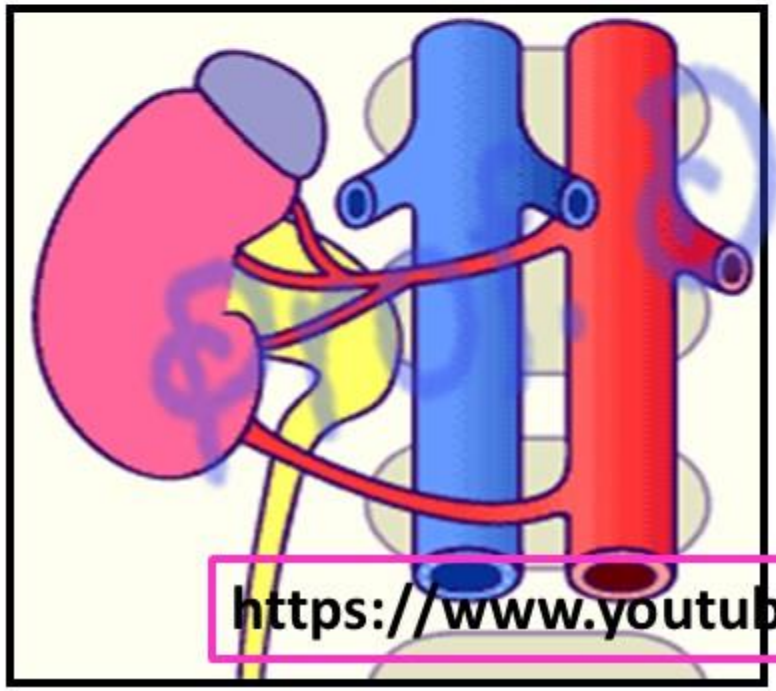
a. **Pelvic kidney:** failure of the ascent of one or both kidneys to their normal positions.

b. **Incomplete ascent:** it ascends but not reaches its terminal position.

c. **Ectopic kidney** due to abnormal ascent.

d. **Mobile (floating) kidney** Nephroptosis,: Not fixated to posterior abdominal wall, a lack of perirenal fat and fascial support. The kidney is movable with changes of body position. This lead to torsion of renal artery or ureter (Dietl's disease)





• Abnormalities of blood supply:

A- Aberrant renal artery: a **persistent** artery during its ascent (enter through hilum).

B- Accessory renal artery: additional artery enters the kidney at its **lower pole.**

• Lateral rotation of the kidney:

As a result, the **hilum** is directed **laterally** and the ureter and renal vessels pass in front of the kidney.

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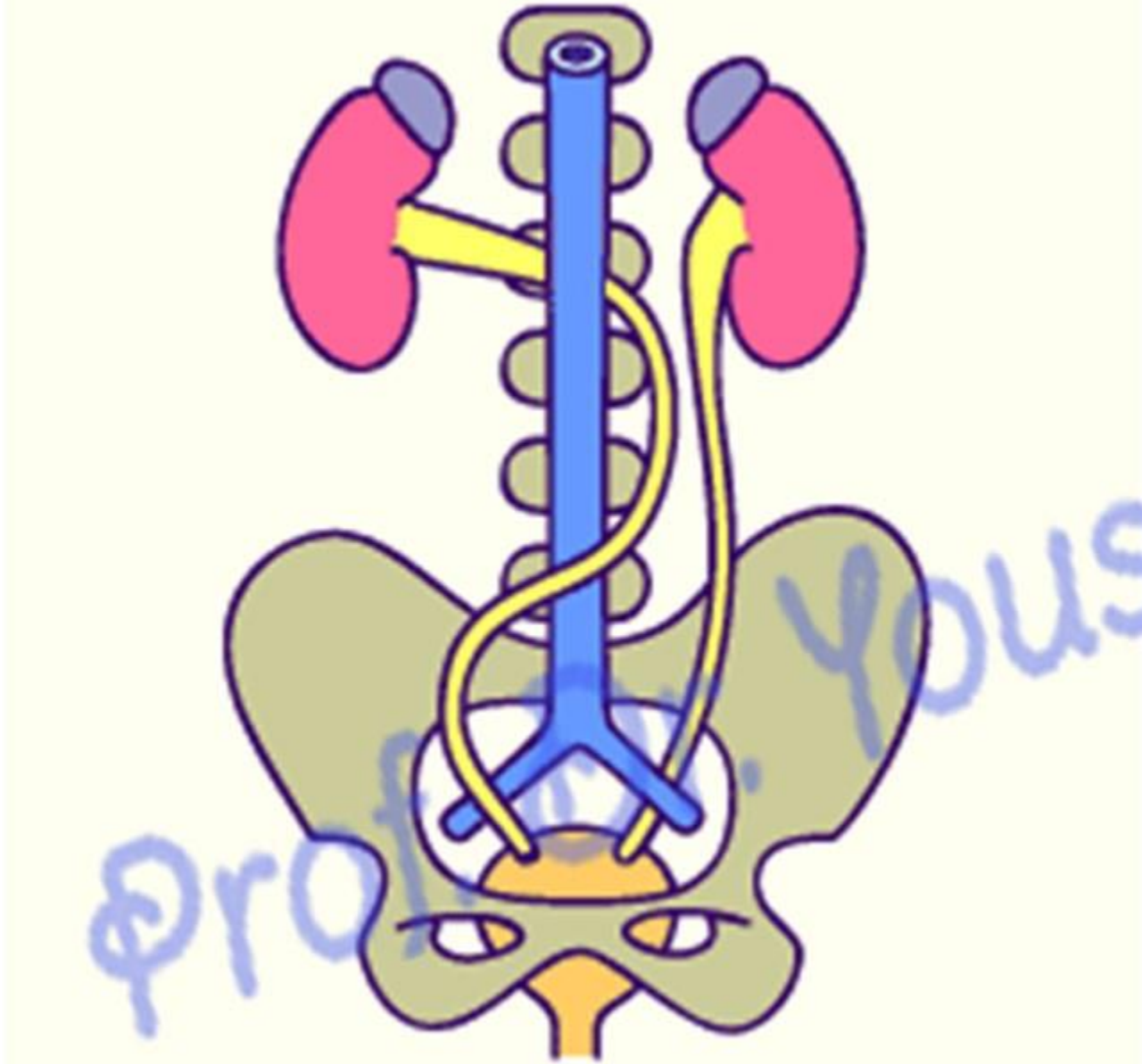

- **Postcaval ureter:** passes behind inferior vena cava leading to obstruction of the ureter.

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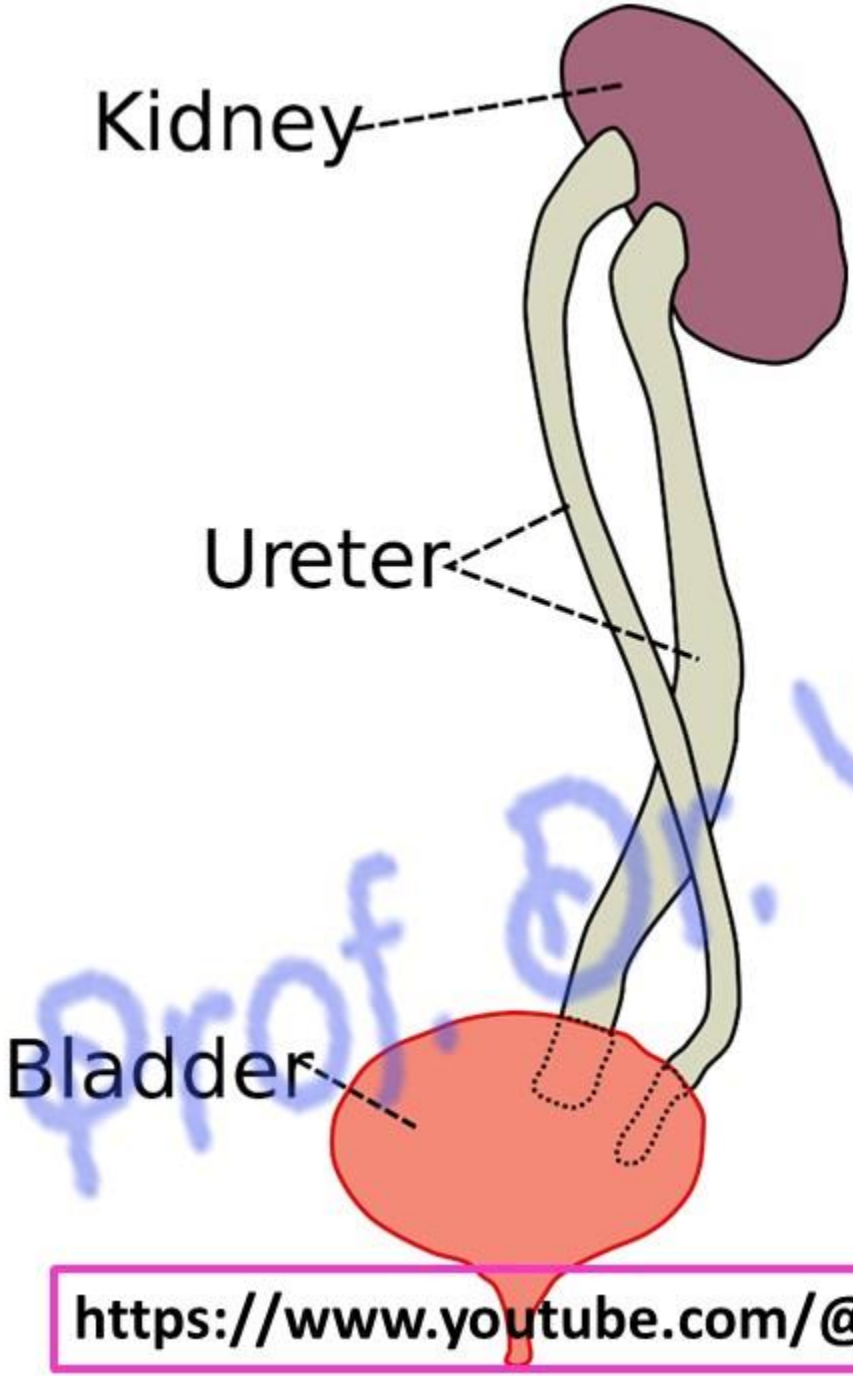
- **Unilateral double kidneys with one ureter**.

- caused by **complete division** of the **distal end** of the **ureteric bud** **before contact** to intermediate mesoderm

- **Bifid ureter with one kidney**: **splitting of the distal end of** ureteric bud **after contact** to intermediate mesoderm



Double ureters with Single kidney:

The ureteric bud splits completely after contact to intermediate mesoderm

Most people don't have symptoms or need treatment.

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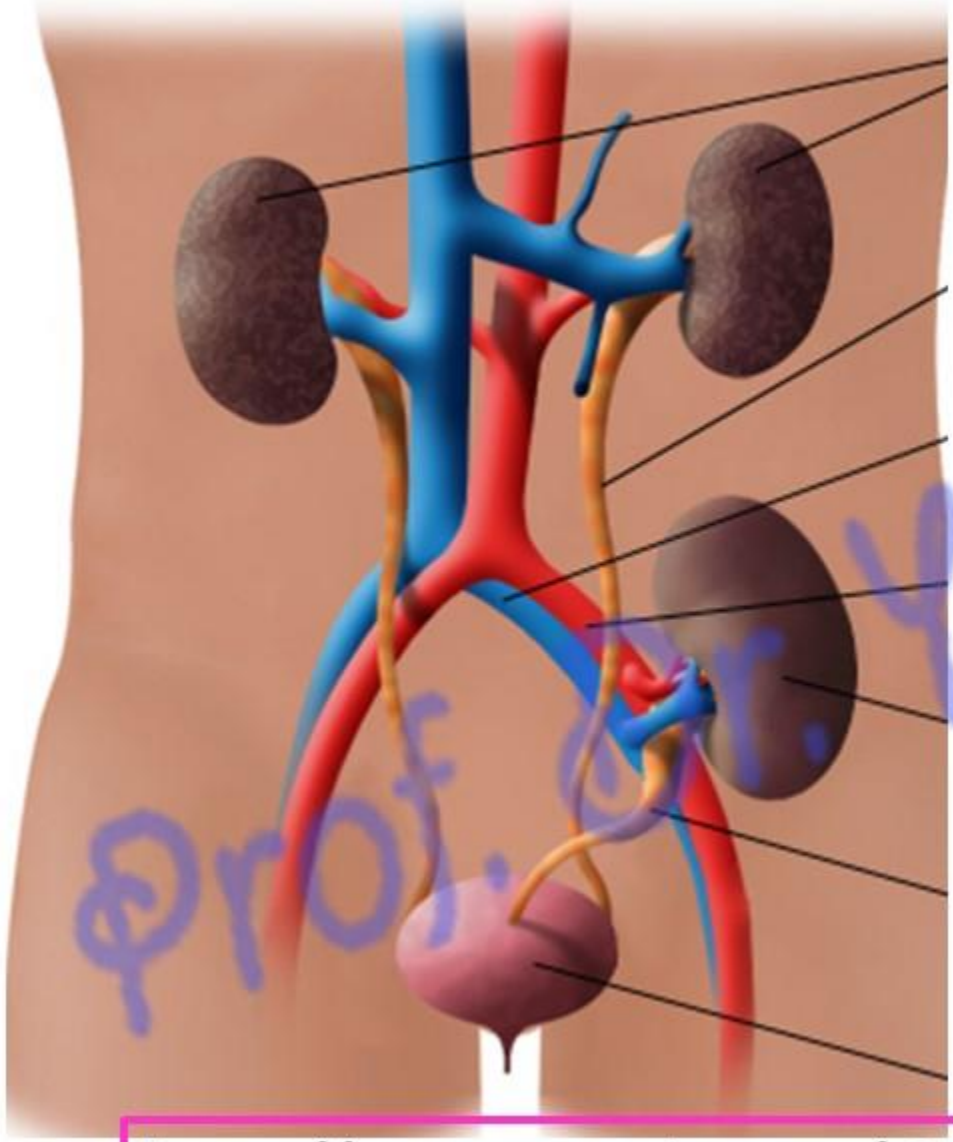

- **Unilateral double kidneys** and **double ureters**
- **Two ureteric buds arise before contact** to intermediate mesoderm

- **Ureteropelvic Junction Obstruction:** Blockage where the ureter meets the kidney, causing hydronephrosis (fluid buildup).
- **Ureterovesical Junction Obstruction:** Blockage at the entry point of the bladder.
- **Vesicoureteral Reflux (VUR):** Abnormal urine flow backward from the bladder into the ureters and kidneys, increasing UTI risks.
- **Ureterocele:** Cystic dilation of the distal ureter.

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Thank you

Questions

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