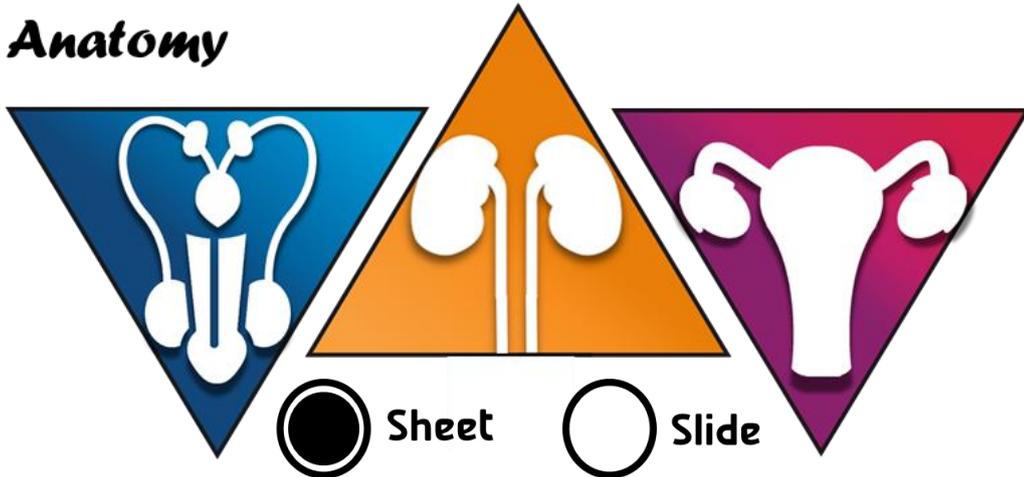




Urogenital system

Anatomy



Number:

-10

Done by:

- Luma Taweel

Corrected by:

- Rand Khreisat

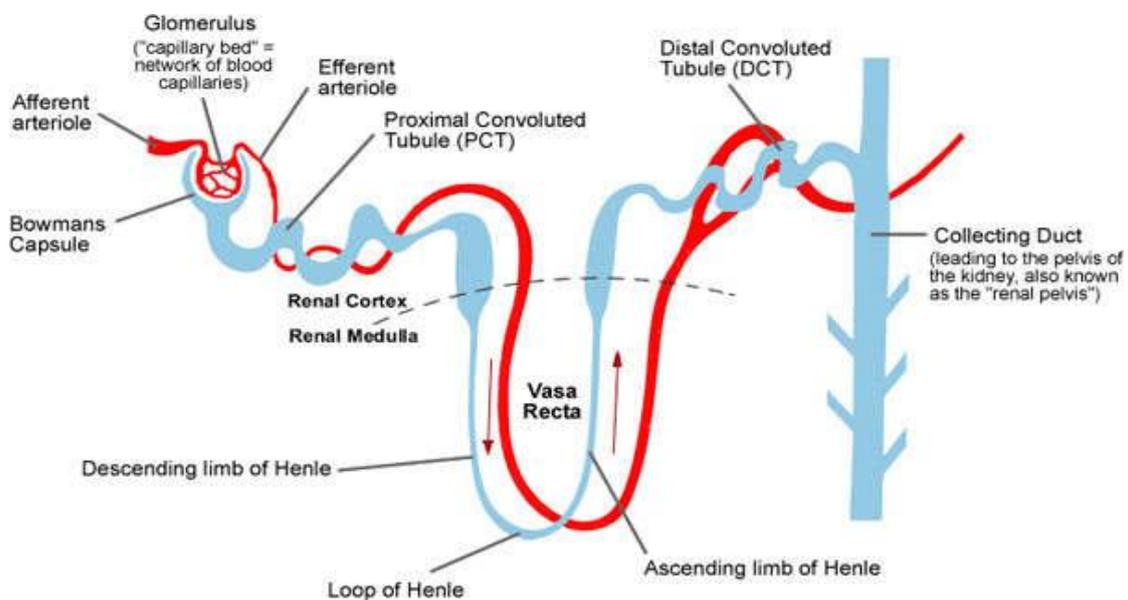
Doctor:

- Ahmad Salman

This is the first embryology sheet, please refer to the slides.

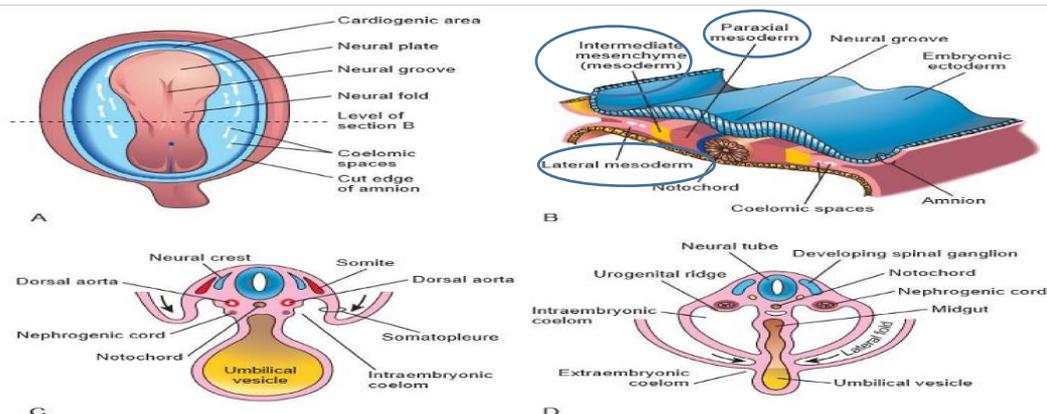
Before we start the embryology of the urinary system, remember that the kidney is composed of nephrons and the collecting system.

- The nephron is composed of the renal corpuscle (bowman's capsule surrounding the glomerulus), the proximal convoluted tubules, the loop of Henle, and then the distal convoluted tubules that end in the collecting duct.
- The collecting duct is the beginning of the collecting system, that will empty urine into minor calyces then into major calyces, then into renal pelvis and finally into the ureter.



The development of the kidneys:

At the midline of the embryo there is a notochord, that is surrounded by three **pairs** of mesoderm, from medial to lateral: the paraxial mesoderm, intermediate mesoderm, lateral mesoderm.



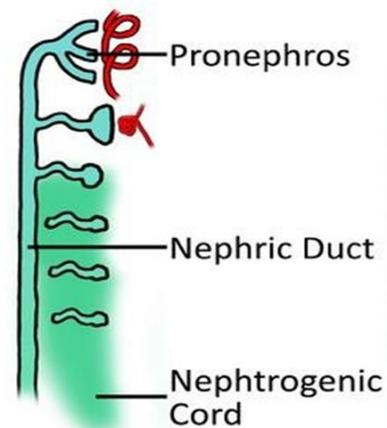
- The development of the kidney and the urinary system begins in the intermediate mesoderm.
- The development of the kidney will pass through 3 stages:
 1. Pronephros tubules and duct
 2. Mesonephros tubule and duct
 3. Metanephros (ureteric bud and metanephric cap)

- Pronephros stage

Intermediate mesoderm in the cervical region at 4th week will form small blocks called **nephrotomes**, these nephrotomes canalize to form the **pronephric tubules**.

The pronephric tubule will receive arterial supply at its medial side, and at the lateral side these tubules unite to form **pronephric duct**.

The pronephric tubules and their arterial supply will degenerate, and the pronephric duct will be transformed to mesonephric duct.



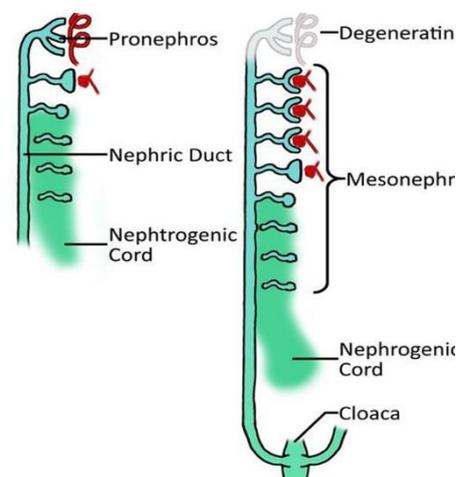
- mesonephric stage

The intermediate mesoderm in the thoracic and lumbar region will form small blocks that canalize and form **mesonephric tubules**.

The mesonephric tubules will receive an artery from its medial side that will form glomerulus and the tubule will form a cap around the glomerulus to form bowman capsule.

The mesonephric tubule will unite at the lateral side to form **mesonephric duct**.

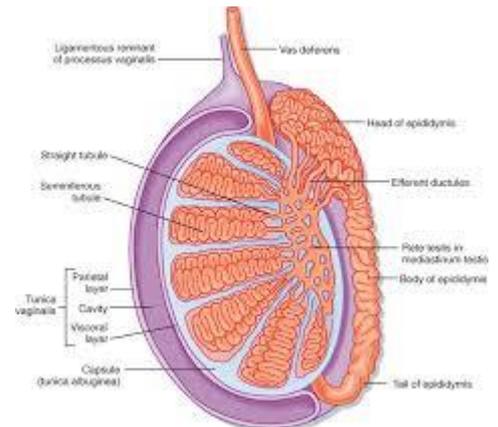
Note: The mesonephric duct will form the urinary system in both males and females, but it will form important structures in the male genital system and rudimentary structures in the female genital system, so it is considered a male duct.



- In males:

In the testis the efferent ductules form the head of epididymis that continue as the body, tail, then vas deferens that ends by joining the seminal vesicle to form the ejaculatory duct.

The **mesonephric tubules** will form the efferent ductules and the head of epididymis, **Paradidymis**



while **the mesonephric duct** will form body, tail, vas deferens, seminal vesicle and ejaculatory duct.

- In females:

In the *female* the **mesonephric tubules** gives **epoophoron, paroophoron and duct** will form Duct of epoophorn and Gartner's duct of the broad ligament of the uterus. (all of these structures are rudimentary)

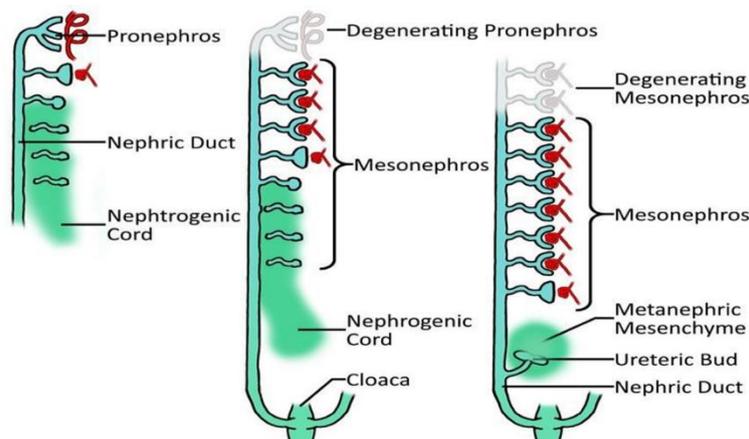
- Metanephric stage

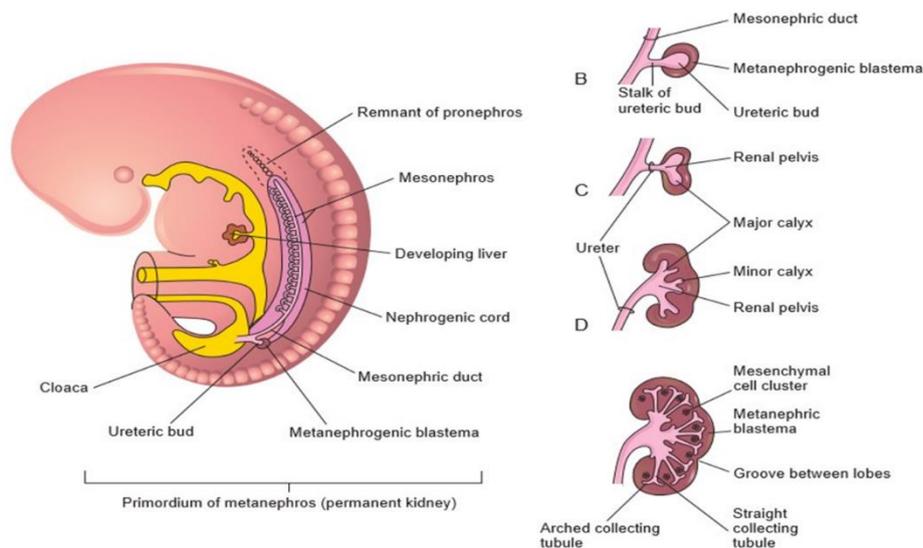
At the sacral region during the 5th month of development, the mesonephric duct opens inferiorly into cloaca. An extension will be formed from the lower part of mesonephric duct near the cloaca to form **ureteric bud**.

The ureteric bud will invade the surrounding mesoderm and form **metanephric cap**.

*The ureteric bud will form ureters, renal pelvis, major calyces, minor calyces, and collecting duct, so the ureteric bud will form **the collecting system**

*The metanephric cap will form, **nephrons, cortex and medulla**.

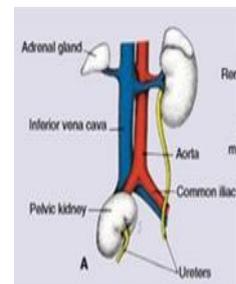




Postnatal changes in the metanephros:

1. Changes in position and blood supply

The kidney is developed in the pelvis, so it will ascend to the abdomen. As it ascends it will change its blood supply from median sacral artery in the pelvis, then from common iliac artery and finally from abdominal aorta.



2. Change in shape

When the kidney was developed, it was lobulated (its surface is full of lobules), these lobules will disappear and its surface will become smooth.

3. Change in direction

Originally, the hilum of the kidney was directed anteriorly, the kidney will rotate 90° so the hilum will face medially.

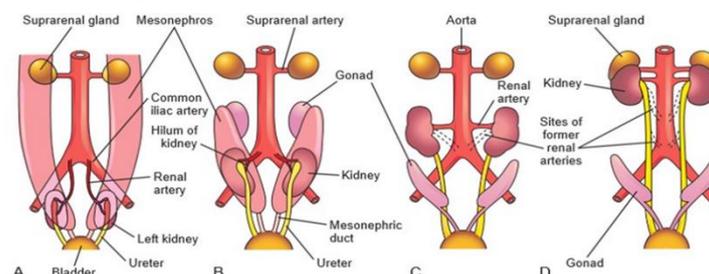
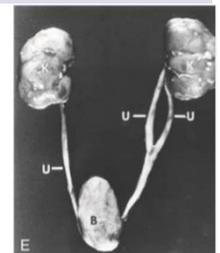
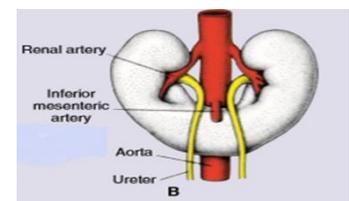


Figure 13-7 A to D, Diagrammatic ventral views of the abdominopelvic region of embryos and fetuses (sixth to ninth weeks), showing medial rotation and relocation of the kidneys from the pelvis to the abdomen. C and D, Note that, as the kidneys relocate (ascend), they are supplied by arteries at successively higher levels and that the hila of the kidneys (where the vessels and nerves enter) are directed anteromedially.

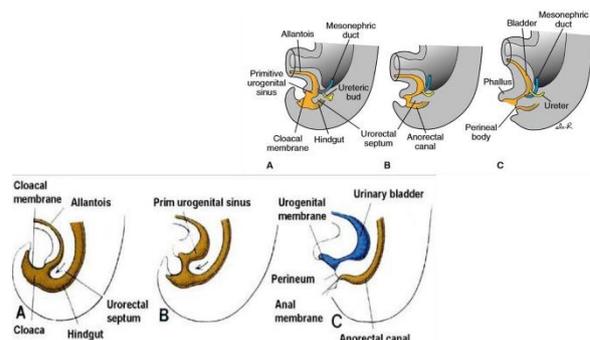
Congenital anomalies of the kidney

1. **Pelvic kidney:** the kidney develops in the pelvis but doesn't ascend to the abdomen
2. **Aberrant renal artery:** as the kidney ascend it took its blood supply from the pelvis. So, the renal artery doesn't arise from the abdominal aorta at the level of L2
3. **Polycystic kidney:** the kidney shows many cysts that is filled with urine, the Cysts are from collecting ducts.
4. **Horse shaped kidney:** the kidneys fuse at the inferior pole, so the ascending of the kidney is prevented by the origin of inferior mesenteric artery at the level of L3.
5. **Bifid ureter:** is due to the bifurcation of the upper end of the ureteric bud with double renal pelvis.
6. **Double ureters:** Occurs when the ureteric bud prematurely divides before penetrating the metanephric cup Results in either a double kidney or duplicated ureter and renal pelvis
7. **renal agenesis:** absence of one or two if the ureteric bud fails to induce the metanephric cap to divide

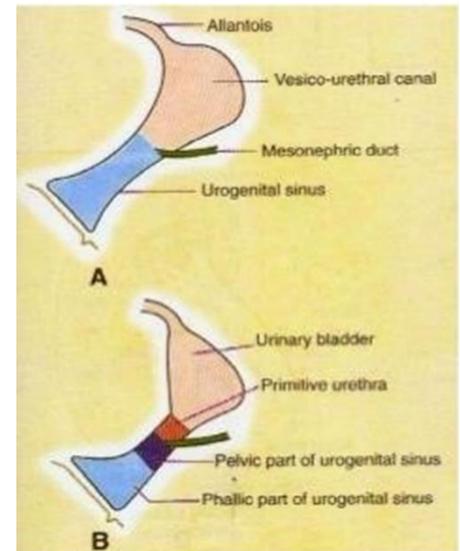


Development of the urinary bladder and the urethra

- The cloaca is the distal end of the hind gut, so it originates from endoderm.
- The cloaca is ventrally continuous with the allantois that is connected to the umbilicus. Inferiorly, it rests on cloacal membrane.



- A longitudinal septum **mesodermal urorectal septum** will divide the cloaca and the cloacal membrane into anterior and posterior parts. The anterior part is the urogenital part that form urinary and genital systems, and the posterior part is the anorectal part that will form rectum and anal cana
- **The remnant of urorectal septum is perineal body and recto vesical fascia (Denonvilliers' fascia)**
- I.
- The mesonephric duct opens into the cloaca, specifically the urogenital part.
- The entry of the mesonephric duct will divide the urogenital part into superior vesicourethral canal and definitive urogenital sinus. The definitive urogenital sinus is further divided into superior pelvic and inferior phallic parts.
- The bladder has the same origin in both male and females, but the development of the urethra differs



- **The development of male urinary bladder and urethra:**

The male urethra is divided into preprostatic (*not important*), prostatic, membranous and penile urethra. The prostatic urethra is divided by the seminal colliculus into supracollicular and infracollicular parts.

The **vesicourethral canal** will form the urinary bladder and supracollicular part of prostatic urethra, except the trigone and posterior wall of supracollicular urethra that is formed by absorption of mesonephric duct.

The **pelvic part** will form infracollicular and membranous urethra.

The **phallic part** will form the penile urethra except its **distal** part, that originate from the ectoderm, which will invaginate from outside and form navicular fossa.

So, the urinary system is formed from a combination of endoderm, mesoderm and ectoderm:

- **Urinary bladder and supracollicular part of urethra:** mostly endoderm except the trigone and the posterior wall which is mesoderm.
- **The infracollicular part of urethra and membranous urethra:** all from endoderm.
- **The penile urethra:** from endoderm and its inferior end from ectoderm.

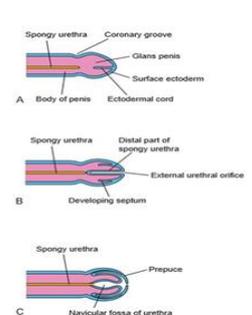
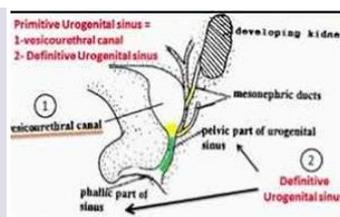
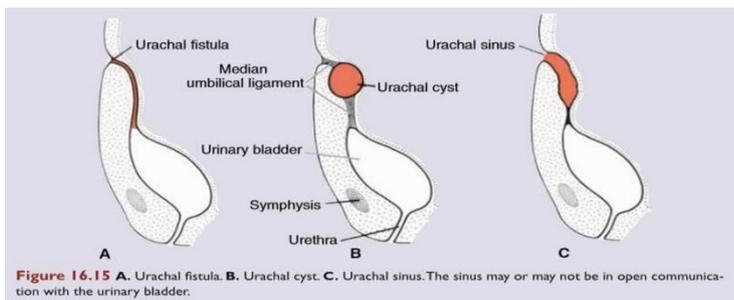
Development of female urinary bladder and urethra:

The urinary bladder and the urethra will originate from vesicourethral canal (endoderm), except the trigone and the posterior wall of urethra will be formed by the absorption of mesonephric duct (mesoderm) and the inferior part of urethra will originate from the ectoderm.

So female urethra has the same origin as the supracollicular part of male urethra except its inferior part.

- The **allantois** will obliterate to form the urachus, that will be transformed after birth to median umbilical ligament.

Congenital anomalies of the bladder:



- 1. Ectopia vesica:** a defect in the anterior abdominal wall that will cause the mucosa of the bladder to be exposed to the exterior. Ectopia vesica is usually associated with epispadias.
- 2. urachal fistula:** when the **urachus** remains open and fails to obliterate, urine will exit through umbilicus.

- 3.** urachal sinus: when the urachus obliterate near the bladder and remain open near the umbilicus.in this case urine won't reach the umbilicus
- 4.** urachal cyst: when the proximal and distal parts of the urachus obliterate, and the middle part remain intact it will dilate and form a cyst.

The end