Embryology Of urogenital system

2018-2019

DR. Hassna B. Jawad

Objective learning :

At the end of the lecture you should be able to :

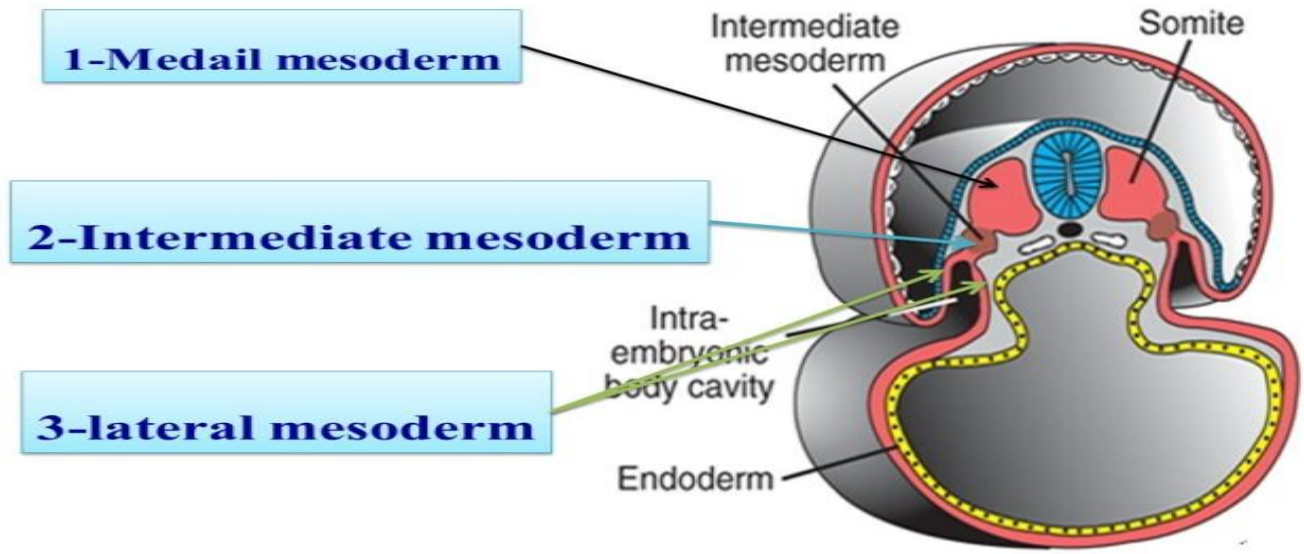
Know Origin of urogenital system from the urogenital ridge
Enlist the Structures derived from urogenital ridge
Know the 3 sets of successive kidney system
Recognize the pronephron ,its time of appearance ,location and function
Recognize the Mesonephron, its time of appearance ,location and function
Recognize the metanephron ,its source, time of appearance ,location and function
Describe the development of ureter from ureteric bud
Describe the development of collecting duct
Describe Positional changing of kidney and its blood supply
Describe the development of urinary bladder from urogenital sinus
Describe the development of urethra from urogenital sinus

Origin Of Urogenital sinus

Two embryonic structures play an important part in the development of urogenital system:

1-Intermediate mesoderm

2-Cloaca



The urogenital system develops from the intermediate mesenchyme (mesoderm) – Urogenital Ridge.
The part of the urogenital ridge giving rise to the urinary system is the nephrogenic cord and the part giving rise to the genital system is the gonadal ridge.

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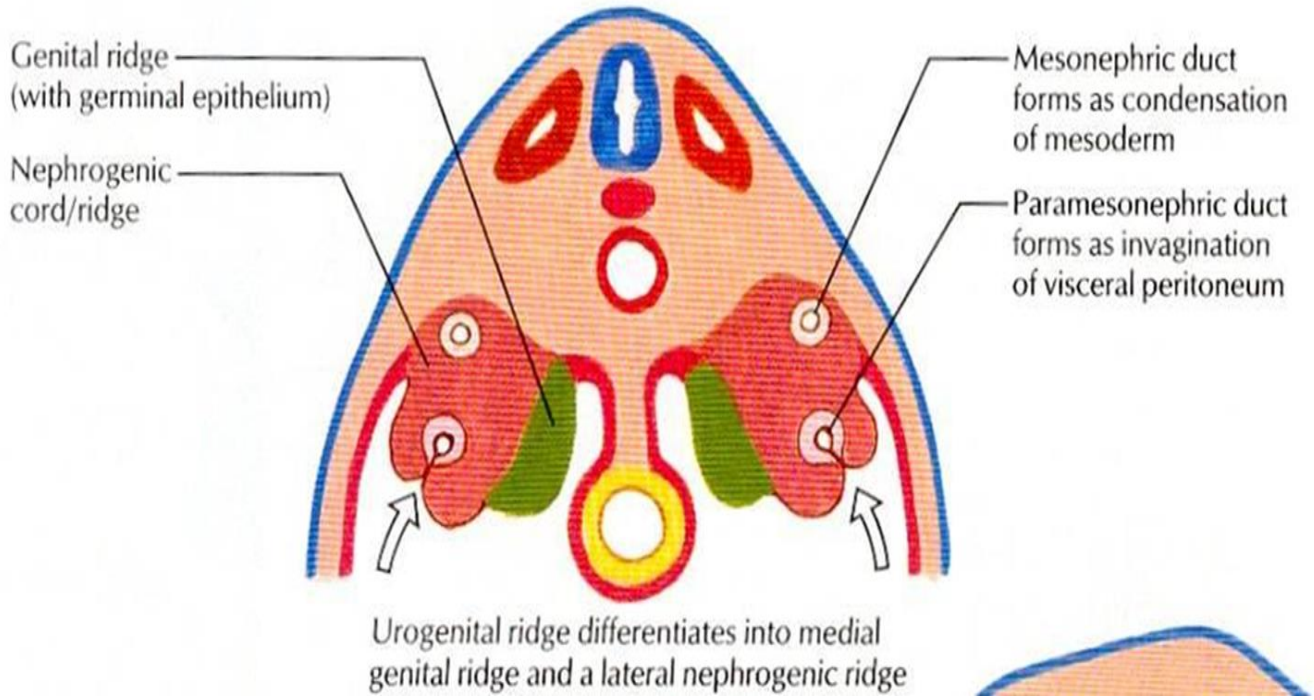
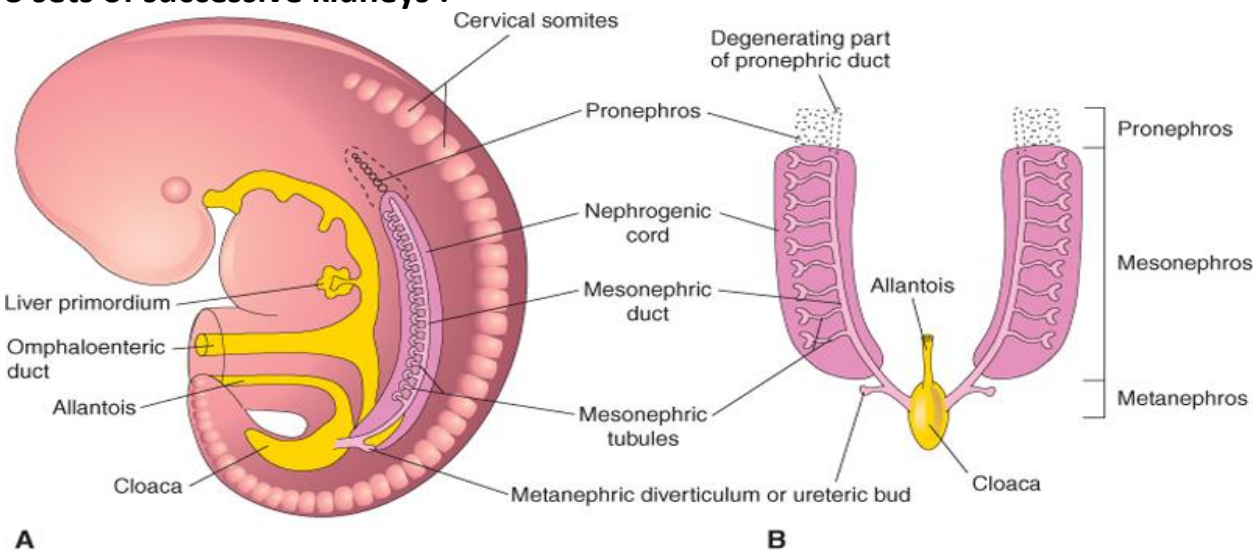


Development of urinary system:

3 sets of successive kidneys :

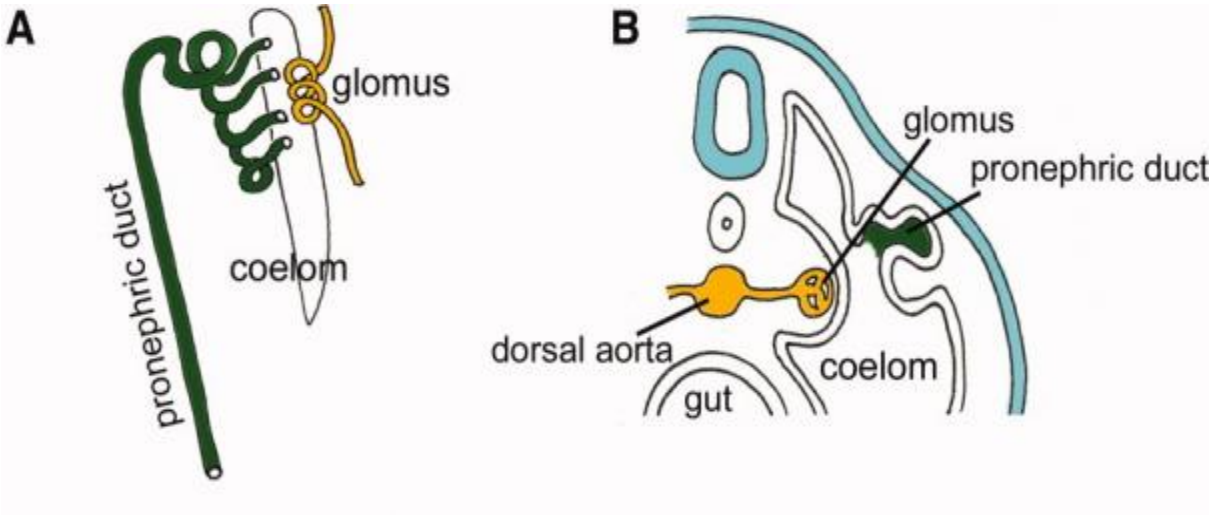


Pronephron:

These bilateral structures appear early in the fourth week. Segmented division of intermediate mesoderm form a few cell clusters and 5-7 pairs pronephric tubules in the cervical region. One end of the tubules opened at coelomic cavity and the other end opened in to pronephric duct

Function : The tubules transmits the waste product from coelomic cavity to the pronephric duct that runs caudally and open into the Cloaca .

Fate : The pronephroi soon degenerate by the end of 4th week ; however, most parts of the pronephric ducts persist and are used by the next set of kidneys.



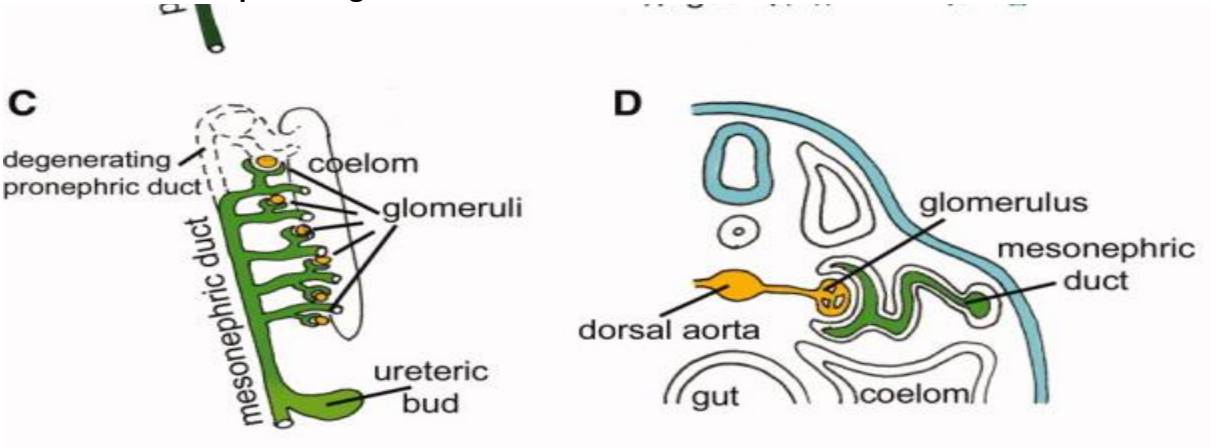
Mesonephrone:

These large, elongated excretory organs appear late in the 4th week , caudal to the pronephroi. The mesonephroi are well developed and function as interim kidneys for approximately 4 weeks, until the permanent kidneys develop and function.

The mesonephric kidneys consist of glomeruli (10–50 per kidney) and 70-80 S shaped tubules. The medial end of mesonephric tubules invagenated by capillaries from dorsal aorta forming glomerulus and laterally open into mesonephric ducts which open into the cloaca.

Function : the glomeruli filtrate the blood and transmits the waste product to the mesonephric duct and then cloaca

Fate :The mesonephroi degenerate toward the end of the second month.



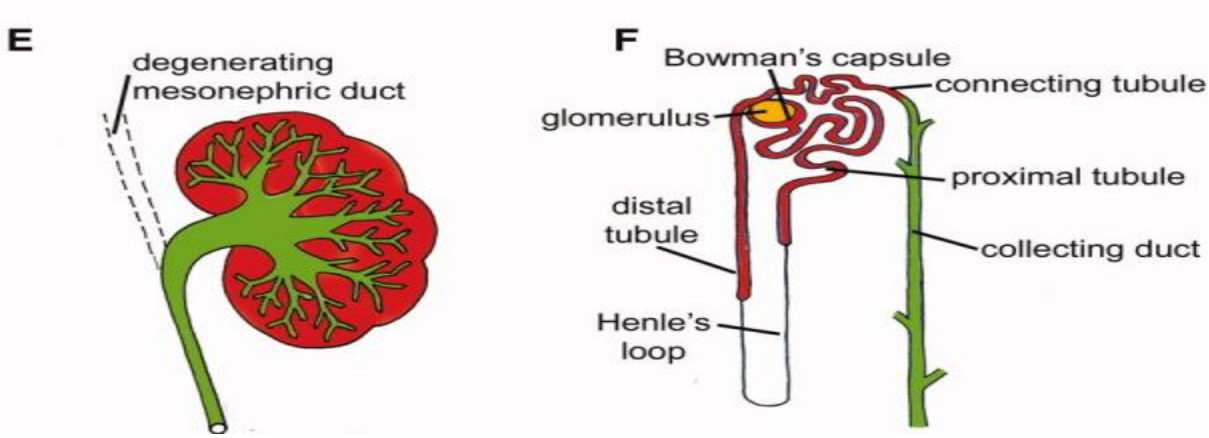
Metanephrone:

Metanephroi—primordia of permanent kidneys—begin to develop in the 5th week and become functional approximately 4 weeks later.

The permanent kidneys develop from two sources:

(1) The ureteric bud (metanephric diverticulum) which gives rise to collecting part of the kidney that includes (ureter ,kidney pelvis ,major and minor calycesand collecting tubules

(2) (metanephric cup) gives the nephron (excretory system) that includes the (Bowmans capsule ,distal and proximal convoluted tubules and loop of Henle)



Development of Kidneys and Ureters:

•The ureteric bud is a diverticulum (outgrowth) from the mesonephric duct near its entrance into the cloaca.

• The metanephrogenic blastema is derived from the caudal part of the nephrogenic cord.

• As the ureteric bud elongates, it penetrates the metanephrogenic blastema—a metanephric mass of mesenchyme.

Collecting system

• The stalk of the ureteric bud becomes the ureter.

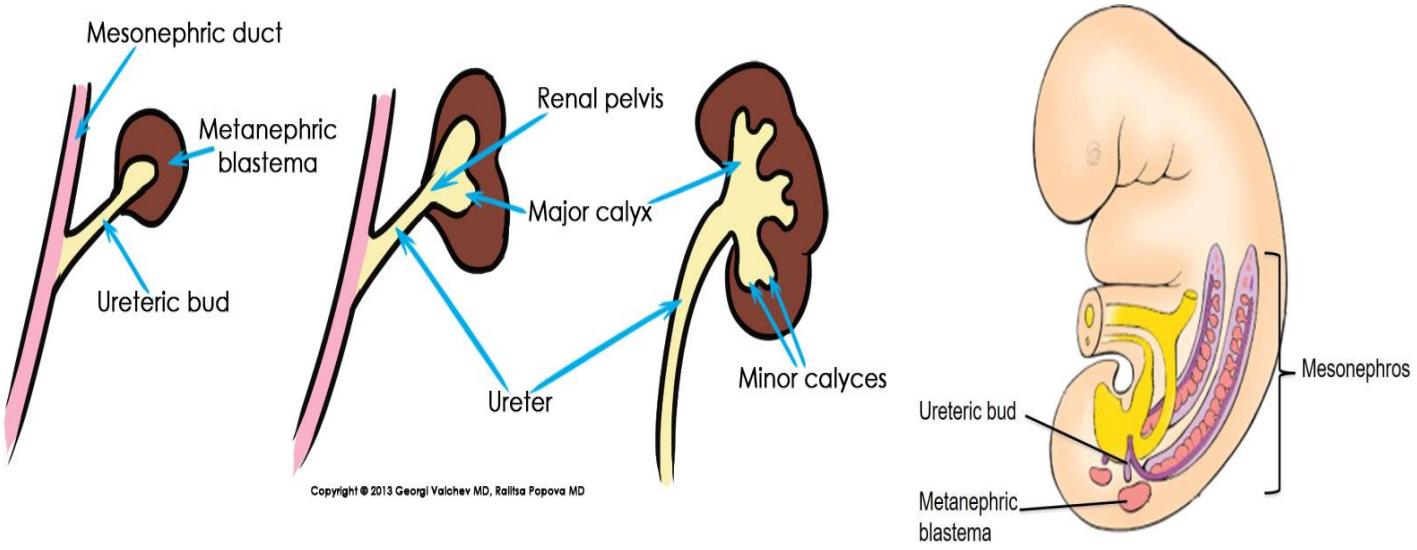
• The cranial part of the bud undergoes repetitive branching, forming branches which differentiate into the collecting tubules of the metanephros.

• The first four generations of tubules enlarge to form the major calices, and the second four generations coalesce to form the minor calices.

Excretory system

Each collecting tubule from the collecting system is covered by a metanephric tissue cap which gives rise to the excretory tubules

• The end of each arched collecting tubule induces clusters of mesenchymal cells in the metanephrogenic blastema to form small metanephric vesicles that differentiated into metanephric excretory tubules .



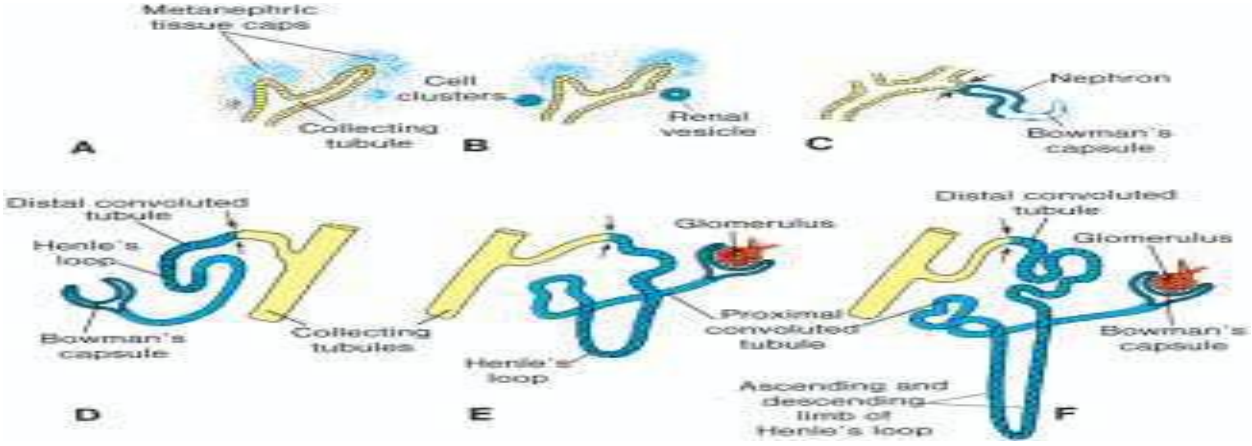
• The tubules differentiate into proximal and distal convoluted tubules, and the nephron loop (Henle loop).

•The proximal convoluted tubules are invaginated by glomeruli, together with the glomerulus and its capsule, constitute a nephron.

• Each distal convoluted tubule contacts an arched collecting tubule, and the tubules become confluent. Between the 10th and 18th weeks, the number of glomeruli increases gradually and then increases rapidly until the 32nd week.

• The increase in kidney size after birth results mainly from the elongation of the proximal convoluted tubules as well as an increase of interstitial tissue.

• Nephron formation is complete at birth except in premature infants. Although glomerular filtration begins at approximately the ninth fetal week, functional maturation of the kidneys and increasing rates of filtration occur after birth.



Positional Change of kidney

Initially the primordial permanent kidneys lie close to each other in the pelvis.
As the abdomen and pelvis grow, the kidneys gradually relocate to the abdomen and move farther apart.
They attain their adult position by the ninth week (contact with the suprarenal glands).
This "ascent" results mainly from the growth of the embryo's body caudal to the kidneys
Initially the hilum of each kidney, , face ventrally; however, as the kidneys ascend, they rotate medially almost 90 degrees.
By the ninth week, the hila are directed anteromedially. Eventually the kidneys become retroperitoneal (external to the peritoneum) on the posterior abdominal wall.

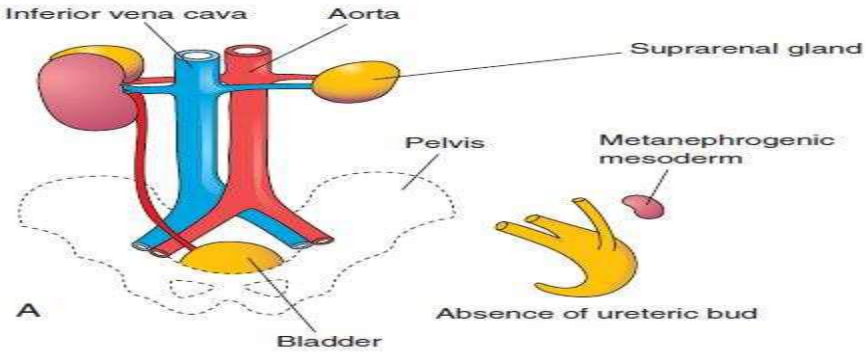
Change in the blood supply of kidney:

The definitive kidney initially develops in the pelvic region before ascending into the abdomen. In the pelvis, the kidney receives its blood supply from a pelvic branch of the abdominal aorta and as it ascends, new arteries from the abdominal aorta supply the kidney (renal arteries). The pelvic vessels usually regress, but can persist as accessory renal arteries.

CONGENITAL ANOMALIES OF KIDNEYS AND URETERS:

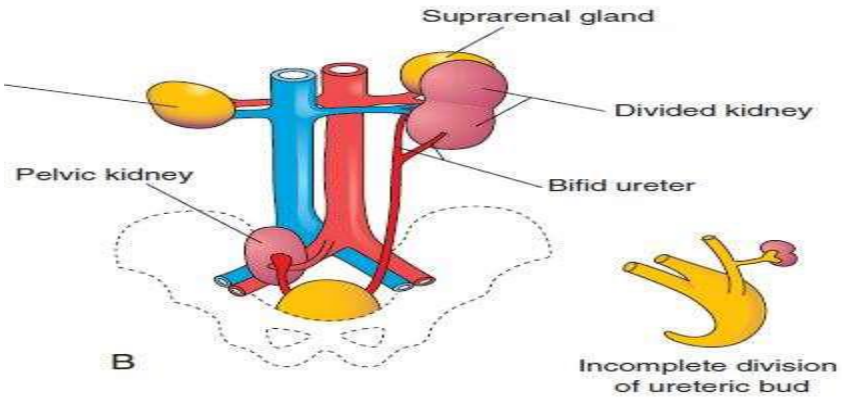
Renal Agnesis:

Renal Agenesis (absence): Can be unilateral or bilateral
• Renal agenesis results when the ureteric buds do not develop or the primordia (stalks of buds) of the ureters degenerate.
• Failure of the ureteric buds to penetrate the metanephrogenic blastema results in failure of kidney development. Infants with bilateral renal agenesis usually die shortly after birth.



Ectopic Kidney

One or both kidneys may be in an abnormal position.
• Most ectopic kidneys are located in the pelvis, but some lie in the inferior part of the abdomen.
• Pelvic kidneys and other forms of ectopia result from failure of the kidneys to ascend.



Horse Shoe Kidney

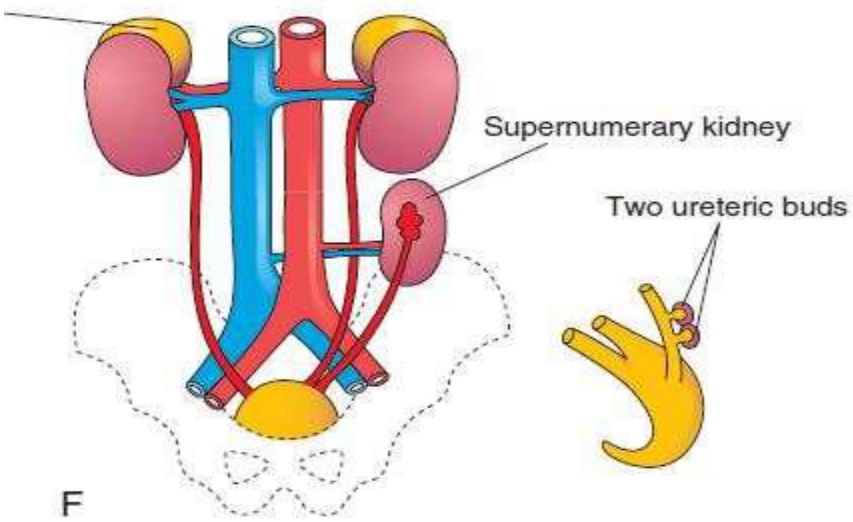
In 0.2% of the population, the poles of the kidneys are fused; usually it is the inferior poles that fuse.

• The large U-shaped kidney usually lies in the pubic region.

• Normal ascent of the fused kidneys is prevented because they are held down by the root of the inferior mesenteric artery.

Supernumerary kidney:

A supernumerary kidney with its own ureter, which is rare, probably results from the formation of two ureteric buds.



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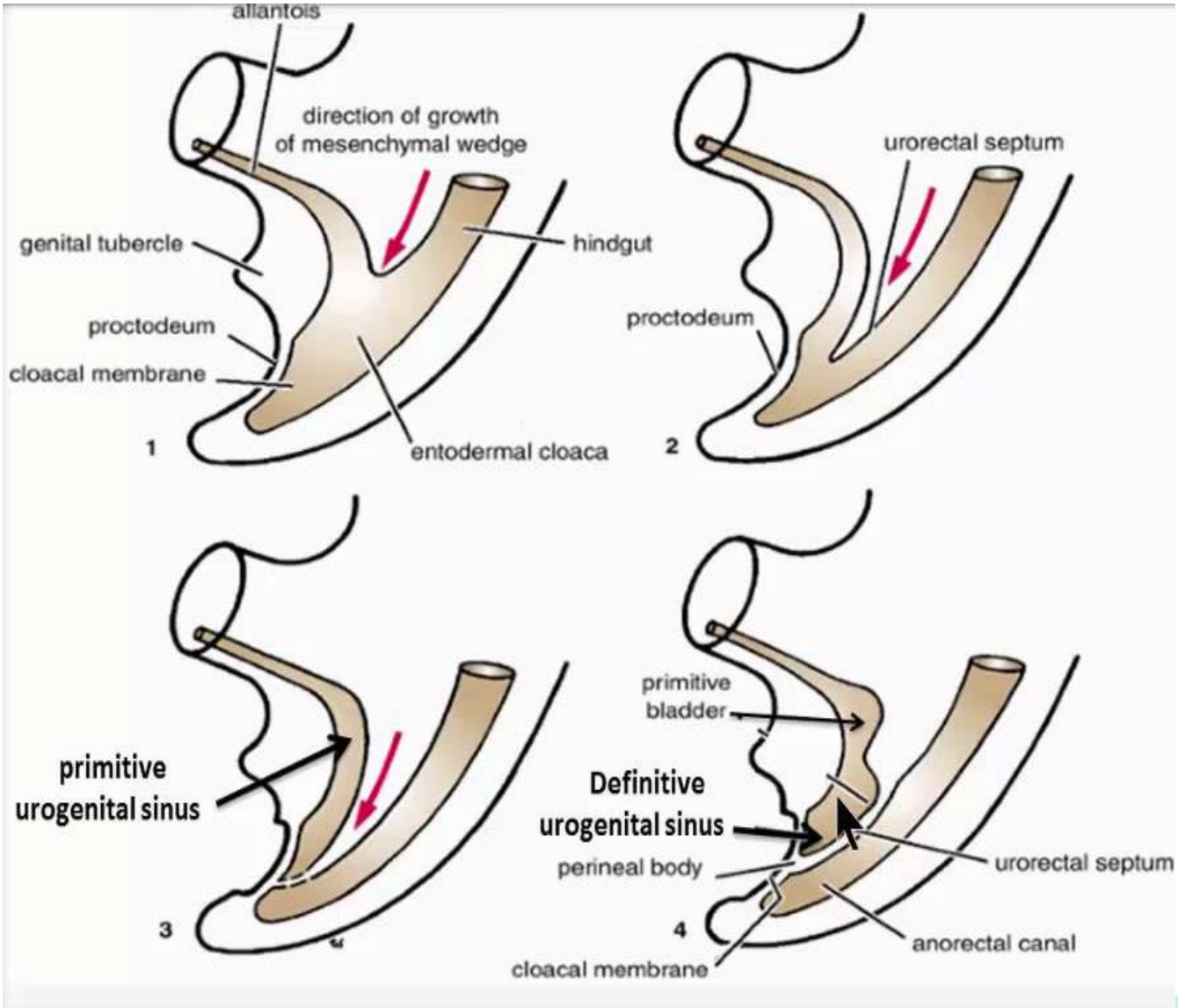
Development of Urinary Bladder:

- During the 4th to 7th weeks of development the cloaca divides into the

1.Urogenital sinus anteriorly

2. Anal canal posteriorly.

- The urorectal septum is a layer of mesoderm between the primitive anal canal and the urogenital sinus
- The tip of the septum will form the perineal body.



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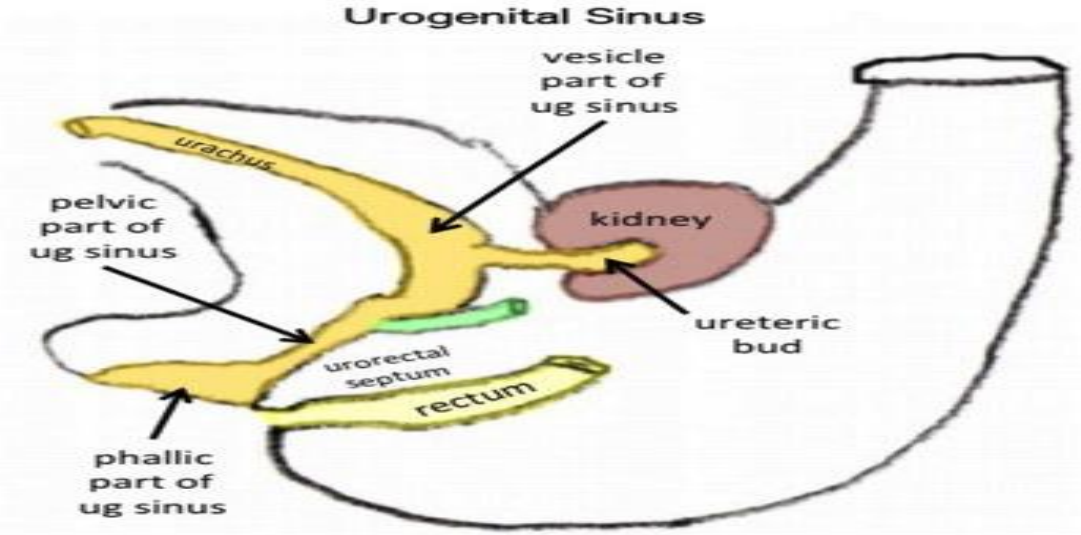
• **Three portions of the urogenital sinus can be distinguished:**

A vesical part (cranial) that forms most of the urinary bladder and is continuous with the allantois.

A pelvic part that becomes the urethra in the neck of the bladder, the prostatic part of the urethra in males, and the entire urethra in females

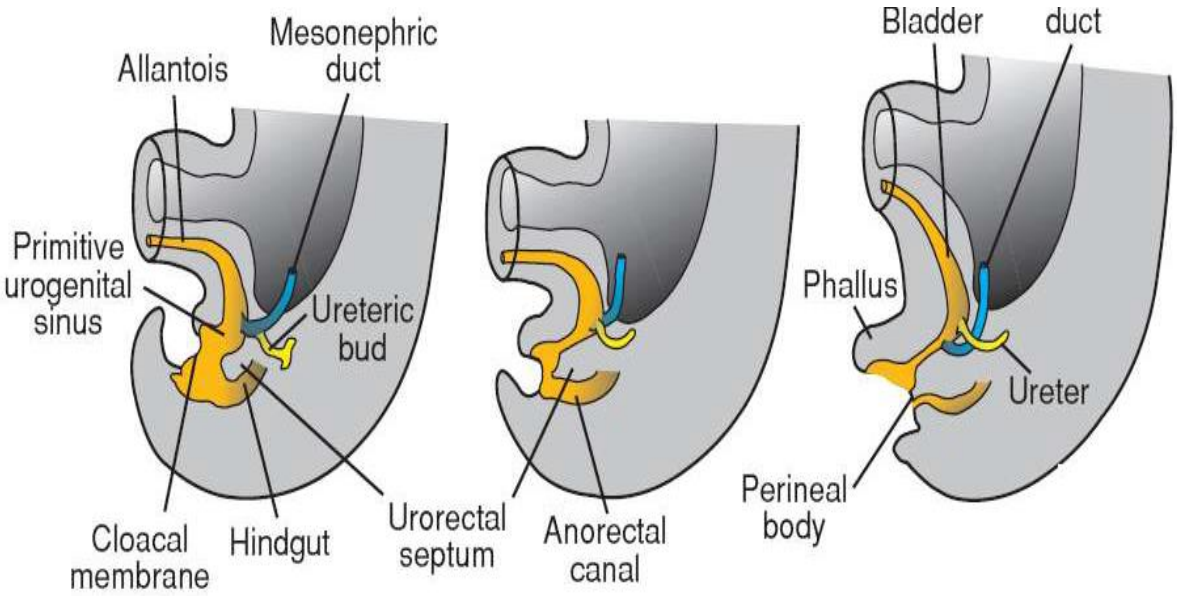
A phallic part (caudal) that grows toward the genital tubercle (primordium of the penis or clitoris



• **The bladder develops mainly from the vesical part of the urogenital sinus but its trigone (triangular area at the base of the bladder between the openings of the ureters) is derived from the caudal ends of the mesonephric ducts.**

• **The entire epithelium of the bladder is derived from the endoderm of the vesical part of the urogenital sinus.**

• **The other layers of its wall develop from adjacent splanchnic mesenchyme.**



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In infants and children, the urinary bladder, even when empty, is in the abdomen.

• It begins to enter the greater pelvis at approximately 6 years of age, but it does not enter the lesser pelvis and become a pelvic organ until after puberty. Initially the bladder is continuous with the allantois. The allantois soon constricts and becomes a thick fibrous cord, the urachus.

URACHAL ANOMALIES

• In infants, a remnant of the urachal lumen may persist in the inferior part of the urachus.

• In approximately 50% of cases, the lumen is continuous with the cavity of the bladder.

• Remnants of the epithelial lining of the urachus may give rise to urachal cysts.

• The inferior end of the urachus may dilate to form a urachal sinus that opens into the bladder. The lumen in the superior part of the urachus may also remain patent and form a urachal sinus that opens at the umbilicus.

• Very rarely the entire urachus remains patent and forms a urachal fistula that allows urine to escape from its umbilical orifice.

A pathologically large urinary bladder—megacystis or megalocystis—may result from a congenital disorder of the ureteric bud, which may be associated with dilation of the renal pelvis.

Extrophy of bladder :A deficiency of the anterior abdominal wall, is caused by incomplete median closure of the inferior part of the wall.

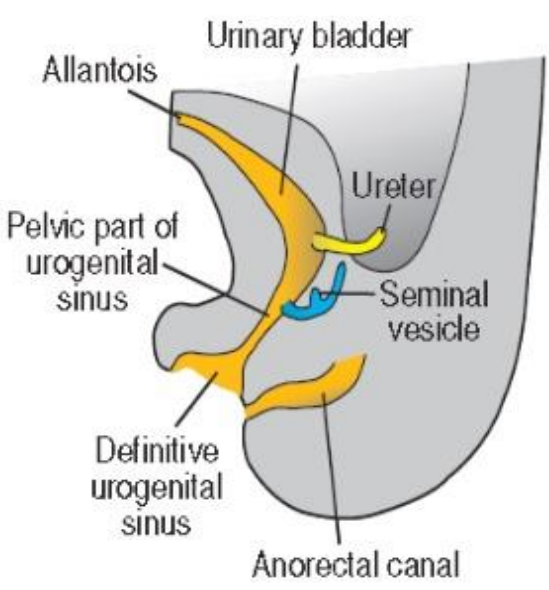
• The defect involves both the abdominal wall and the anterior wall of the urinary bladder; it results from failure of mesoderm to migrate between the ectoderm and endoderm of the abdominal wall.

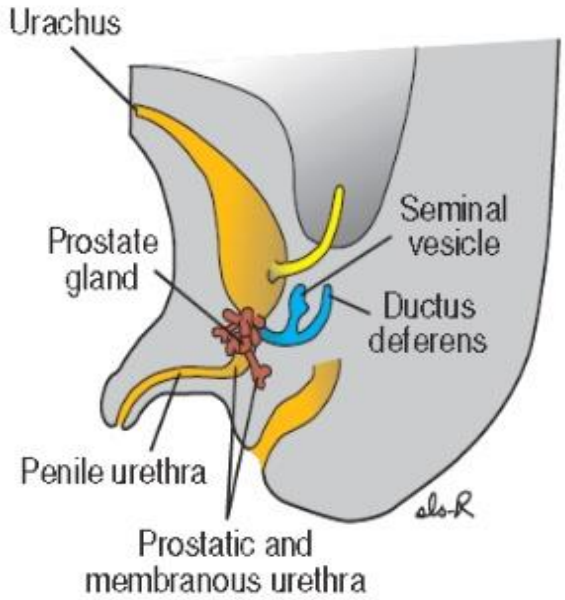
Development of Urethra :

The primitive urogenital sinus is divided by mesonephric ducts into :

1.Vesicourethral canal

2. Definitive urogenital sinus





The upper part of prostatic urethra is derived from distal end of vesicourethral part
The lower part of prostatic urethra and membranous urethra are derived from pelvic part of definitive urogenital sinus .
The penile urethra is derived from phallic part of definitive urogenital sinus

The entire female urethra is derived from endoderm of urogenital sinus