



RENAL BLOCK

Embryology Team Notes

Development of kidneys and ureters

Student Guide:

- 1- The notes, which are written by the team, are in Blue.
- 2- Everything written in **Red** is important.

EMBRYOLOGICAL ORIGIN



INTERMEDIATE MESODERM

Differentiates into:

Lateral

Nephrogenic ridge (cord)

Medial

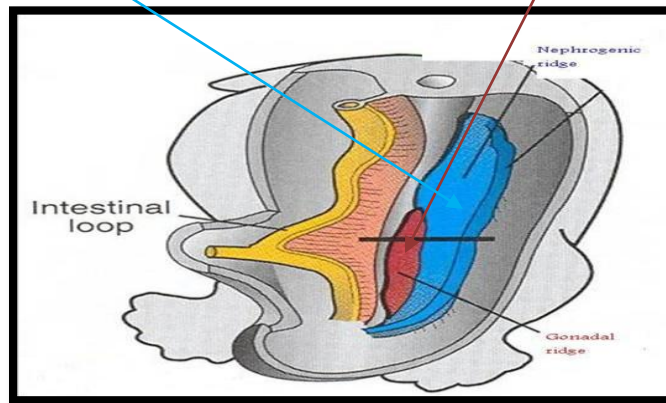
Gonadal ridge



forms kidneys & ureters



forms gonads (testes or ovaries)



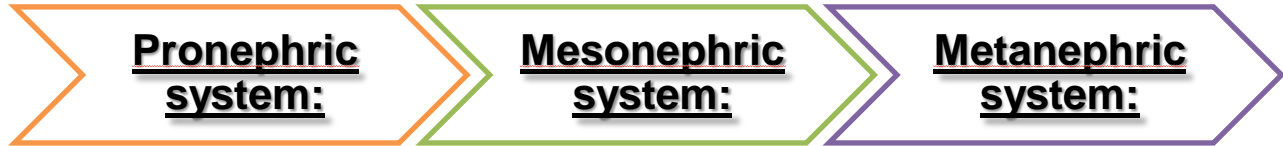
DEVELOPMENT OF KIDNEYS

Three systems of kidney develops:

1-Pronephric system

2-Mesonephric system

3-Metanephric system



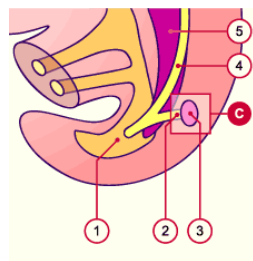
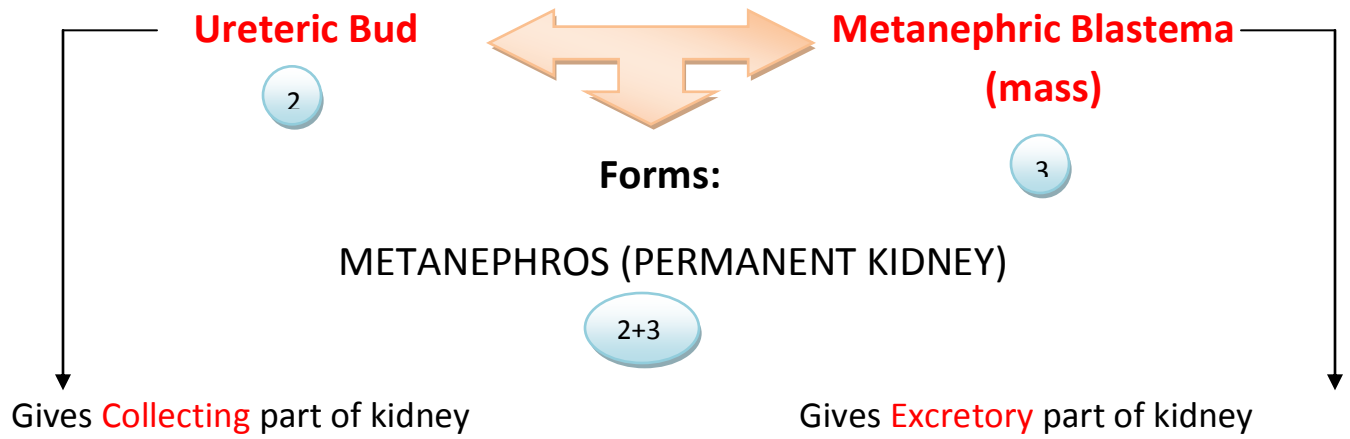
- - appears at beginning of 4th week
- in cervical region
- - analogous to kidney of fish
- - formed of tubules & a duct
- - not function in human
- - disappears

- - appears at end of 4th week
- in thoracic & abdominal regions
- - analogous to kidney of amphibians
- - formed of tubules & a duct
- - function temporarily
- -The duct: In male: forms genital duct
- - In both sexes: forms ureteric bud

- - appears at 5th week in pelvis
- - starts to function at 9th week

- The tubules disappear > ducts remain > its last part (ureteric bud) opens in the anterior aspect of cloaca (which is the bladder later)

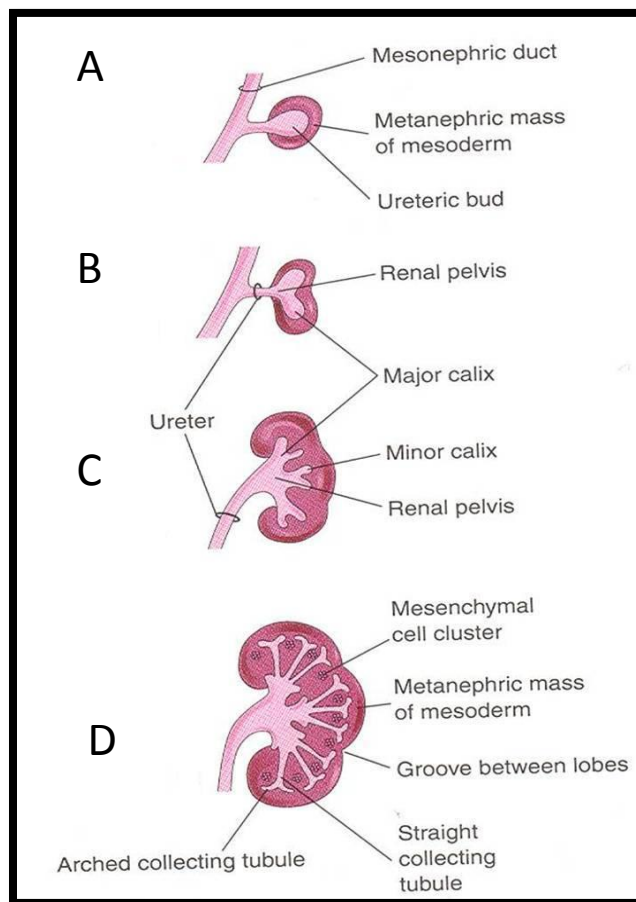
- In females it degenerates



- 1 Cloaca
- 2 Ureter anlage
- 3 Metanephric blastema
- 2+3 Metanephros
- 4 Mesonephric duct (Wolffian duct)
- 5 Nephrogenic cord
- 4+5 Mesonephros

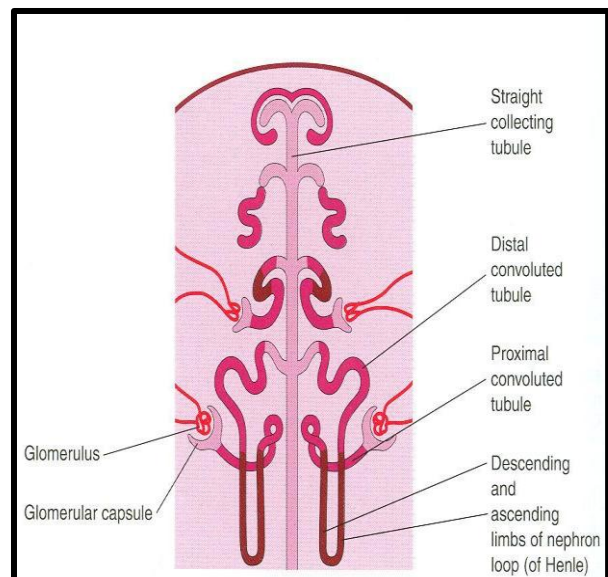
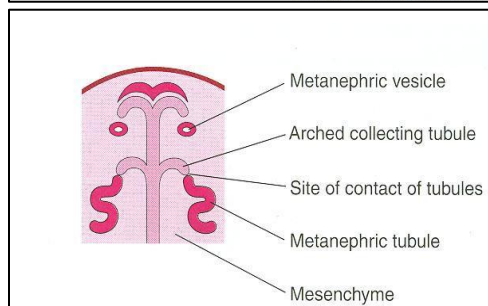
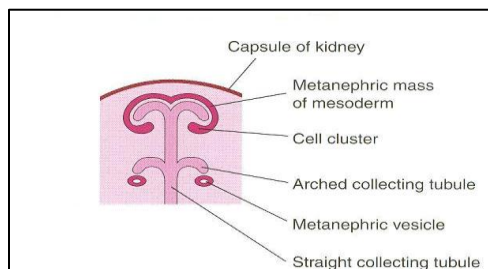
COLLECTING PART

<p>A- Ureteric bud elongates & penetrates metanephric mass.</p>	<p>B- Stalk of ureteric bud forms ureter & its cranial end forms renal pelvis.</p>	<p>C- Branching of renal pelvis gives 3 major calices. Branching of major calyces gives minor calyces.</p>	<p>D- Continuous branching gives straight then arched collecting tubules</p>
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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.
 - 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**



Excretory tubule



Arched collecting tubule

Fused together to form:

THE NEPHRON

(FUNCTIONAL UNIT OF KIDNEY)

*At Full Term: each kidney contains: 800000 – 1000000 nephrons.

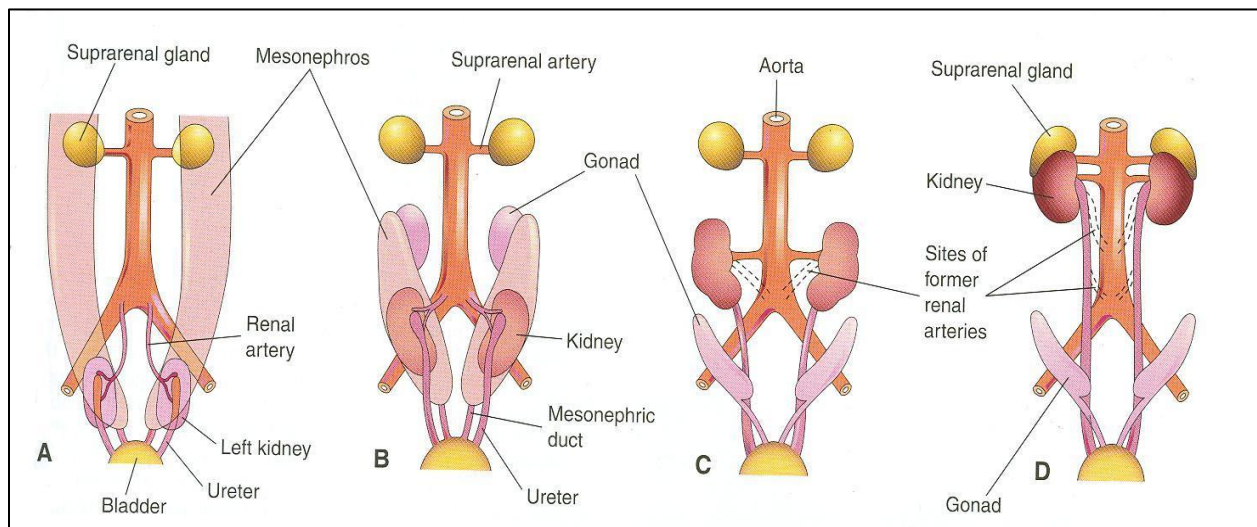
THE FETAL KIDNEY

- The Kidney is subdivided into Lobes that are **visible** externally.
 - Lobulation **diminishes** at the end of fetal period.
 - Nephron formation is **complete** at birth.



CHANGES BEFORE BIRTH

- Position:** The kidney **ascends** from pelvis to **abdomen** & attains its adult position, **caudal to suprarenal gland**.
- 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, the Hilum is **ventral** then rotates **medially about 90°** & becomes medial.



AT THE 9TH WEEK

- *Beginning of glomerular filtration.
- *The kidney attains **its adult position**. Receives its arterial supply from abdominal aorta.
- *The hilum is **rotated medially**

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

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

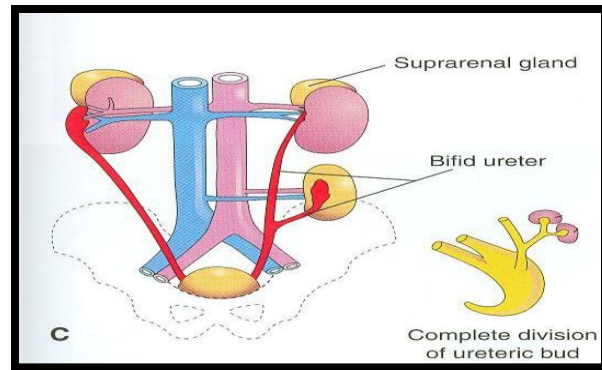
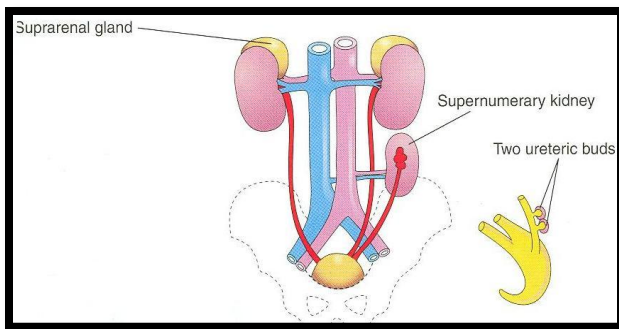
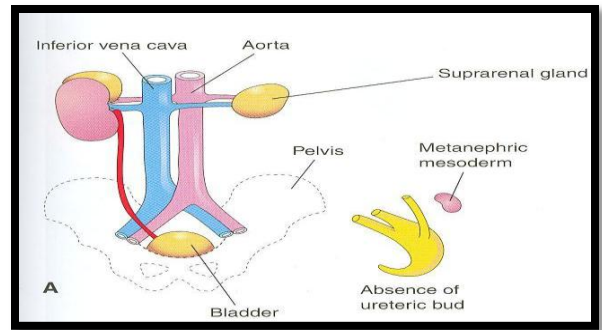
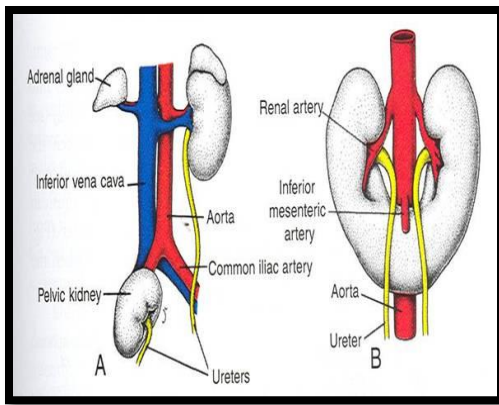
Horseshoe kidney:
the poles of both kidneys (**usually the lower poles**) fuse: **the kidneys have a lower position than normal but have normal function**

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

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

Right side: **malrotation** of kidney
Left side: **bifid** ureter & supernumerary kidney





- No bud > No kidney (unilateral)
- 2 buds > 2 kidneys (super = lucky)
- 1 ureter + 2 kidneys
- U-shaped kidney (Horse-shoe)
- No rotation > remain lateral – ventricle- (malrotation)
- POLYCYSTIC KIDNEYS: separation between collecting and excretory parts (it leads to death)
- <http://www.embryology.ch/quiz/anglais/turinary/urinary14.html> (Anomalies quiz)
- http://www.indiana.edu/~anat550/embryo_main/ (animation)

Summary

- The kidneys and ureters originate from the intermediate mesoderm.
- Three kidney systems develop:
 1. The **pronephroi**, which are **nonfunctional** and form in the **cervical region**.
 2. The **mesonephri**, which serve as **temporary** excretory organs and form in the **thoracic and lumbar region**. In **male**, ducts form the **genital duct** while in **female** these ducts **regress** (otherwise most of the system disappears).
 3. The **metanephri**, which become the **permanent kidneys** and develop from **two** sources:
 - ureteric bud**, which gives rise to the ureter, renal pelvis, callices, and collecting tubules (**collecting part**).
 - metanephric mass**, which gives rise to the nephrons (**excretory part**).
- The fetal kidney subdivided into external Lobes which diminish at the end of fetal period.
- Anomalies:
 1. **Pelvic kidney**: due to **failure** of the kidneys to "**ascend**".
 2. **Horseshoe kidney**: the **poles** of the kidneys are **fused**.
 3. **Unilateral renal agenesis**: due to **absence** of **one ureteric bud**
 4. **Supernumerary kidney**: due to **development** of **2 ureteric buds**.
 5. **malrotation** of kidney remain lateral.
bifid ureter & **supernumerary** kidney.

Timetable of kidneys & ureters development	
Beginning of 4 th week	Pronephric system
End of 4 th week	Mesonephric system
5 th week	Metanephric system
9 th week	<ul style="list-style-type: none"> • Metanephric system starts to function. • Beginning of glomerular filtration. • All changes before birth are completed: <ol style="list-style-type: none"> 1. Adult position: caudal → suprarenal 2. Blood supply: renal branches of common iliac arteries → renal branches of abdominal aorta. 3. Rotation of hilum: ventral → medial.
After birth	<ul style="list-style-type: none"> • Increase in size. • Disappearance of kidney lobulation.

Questions:

1-one of the characteristics of the mesonephric system:

- a) Forms in cervical region.
- b) Appears at the beginning of 4th week.
- c) The duct in this system forms ureteric bud.
- d) It is also called the permanent kidney.

2-one of the changes occurs after birth:

- a) The kidney attains its adult position.
- b) Disappearance of kidney lobulation.
- c) The hilum is rotated medially.
- d) The kidney receives its arterial supply from abdominal aorta.

3-anomaly happened due to development of two ureteric buds:

- a) Supernumerary kidney.
- b) Unilateral renal agenesis.
- c) Pelvic kidney.
- d) Unilateral kidney.

4-Which one of the following structures is a derivative of a metanephric mass:

- a) Ureter.
- b) Collecting tubule.
- c) Renal pelvis.
- d) Proximal convoluted tubules.

Answers: c, b, a, d