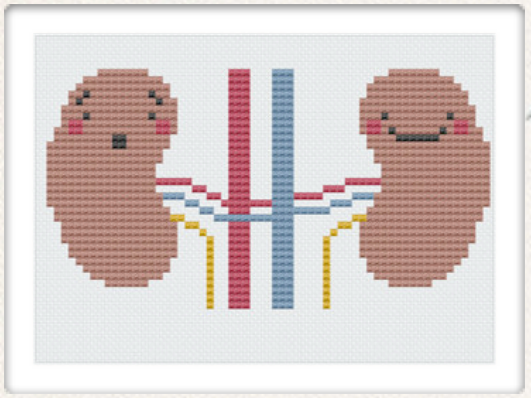


Development Of The Kindeys

Asma Al-Mohizea - Basil Al-Suwaine - Rana Al-Ohaly

Renal block 2013 (First lecture)

objectives:

- Embryological origin
- Differentiate 3 systems of kidneys
- Describe development of collecting/excretory parts of permanent kidney
- Describe fetal kidney
- Identify pre/postnatal changes
- Enumerate common anomalies

Embryological Origin

•**Intermediate mesoderm which divides into:**
1.Nephrogenic ridge: forms kidneys & ureters.
2.Gonadal ridge: forms gonads (testes or ovaries).

Development of the kidneys

•**Development of the kidney is divided into three phases.**

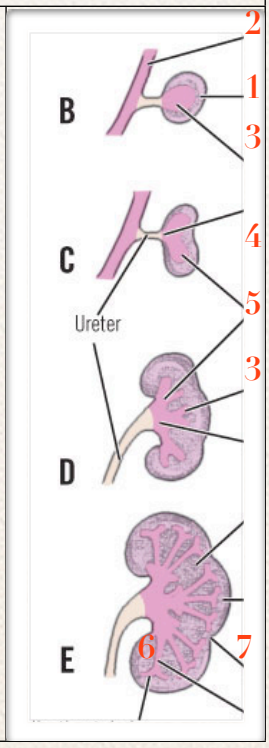
1. Pronephric system:	2. Mesonephric system:	3. Metanephric system:
⋆ Appears at beginning of 4th week in cervical region.	⋆ Appears at end of 4th week in thoracic & abdominal regions.	⋆ Appears at 5th week in pelvis.
⋆ Analogous to kidney of fish. ⋆ Formed of tubules & a duct ⋆ Not functional in humans ⋆ Disappears 	⋆ Analogous to kidney of amphibians. ⋆ Formed of tubules & a duct ⋆ Functions temporarily ⋆ Mesonephric duct: in females only the distal part persists. In males the whole duct persists. 	⋆ Starts to function at 9th week.

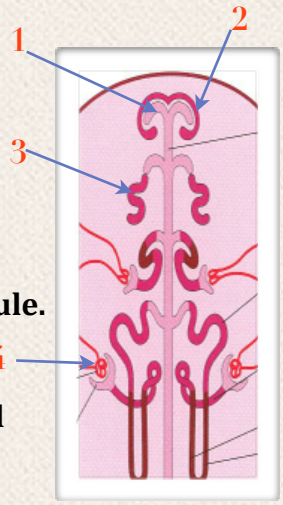
Metanephros

•**Metanephros is the permanent kidney. The previous systems are temporary.**
▪**Formed of 2 origins:**
1)**Ureteric bud (derived from mesonephric duct):**
Gives collecting part of kidney.
2)**Metanephric blastema (mass):**
Gives excretory part of kidney.

COLLECTING PART

- Ureteric bud(1) elongates & penetrates metanephric mass(2)
- Stalk of ureteric bud forms ureter and the cranial end forms renal pelvis(3)
- Branching of renal pelvis gives 3 major calices (4). Branching of major calyces gives minor calyces(5).
- Continuous branching gives straight(6) then arched (7) collecting tubules.





EXCRETORY PART:

- Each arched collecting tubule(1) is surrounded by a cap of metanephric mass(2).
- The metanephric cap forms the metanephric vesicle.
- The metanephric vesicle elongates to form an S-shaped metanephric tubule(3).
- The end of each tubule forms glomerular (Bowman's) capsule.
- Each glomerular capsule is invaginated by capillaries (glomerulus)(4).
- The tubule lengthens to form: proximal & distal convoluted tubules + loop of Henle.
- 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: 800,000 – 1000,000 nephrons.

Changes that occur during development

✱ **By the 9th week:**

•**Change in position: The kidney ascends from pelvis to abdomen & attains its adult position: caudal to the suprarenal gland which halt their ascent.**

•**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 is ventral, then rotates medially about 90° & becomes medial.**

✱ **Changes after birth:**

•**Increase in size due to elongation of tubules and increase in connective tissue between tubules.**
•**The number of nephrons persists throughout adult life. No further increase.**
•**Disappearance of kidney lobulation.**

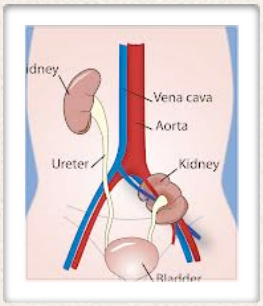
The fetal kidney

•**Glomerular filatration begins at 9th week.**
•**At 9th week, 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. (Not disappear)**
•**Nephron formation is complete at birth.**

Anomalies of the kidney

- **Pelvic kidney: failure of ascent of one kidney (ureter is short)[1].**
- **Horseshoe kidney: the poles of both kidneys (usually the lower poles) fuse; the kidneys have a lower position than normal but with normal function[2].**
- **Unilateral renal agenesis: due to absence of one ureteric bud.**
- **Supernumerary kidney: an additional kidney. Due to development of 2 ureteric buds.**
- **A- Right side (kidney): malrotation of kidney.**

B- Left side (kidney): bifid ureter & supernumerary kidney.



{1}

{2}

- **Kidneys & ureters originates from nephrogenic ridge 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).**

Timeline

- **By 4th week:**
  - **Appearance of Pronephric system (beginning of)**
  - **Appearance of Mesonephric system (end of)**
- **By 5th week:**
  - **Appearance of Metanephric system.**
- **By 9th week:**
  - **Glomerular filtration begins.**
  - **Kidney attains its adult position.**
  - **Kidney receives its arterial supply from aorta.**
  - **Kidney completes rotation.**
- **At full term:**
  - **Nephron formation is complete.**
  - **Lobulation of kidney diminishes.**
- **After birth:**
  - **Lobulation disappears.**
  - **Kidney increases in size due to elongation of existing tubules not due to increase in number of nephrons.**
  -

QUESTIONS

1- Which one of the following events happens by 9th week?

a)**Nephron formation is complete**
b)**Disappearance of kidney lobulation**
c)**Kidney attains its adult position**
d)**Metanephric system appears**

2- Which one of the following structures is a derivative of the metanephric mass?

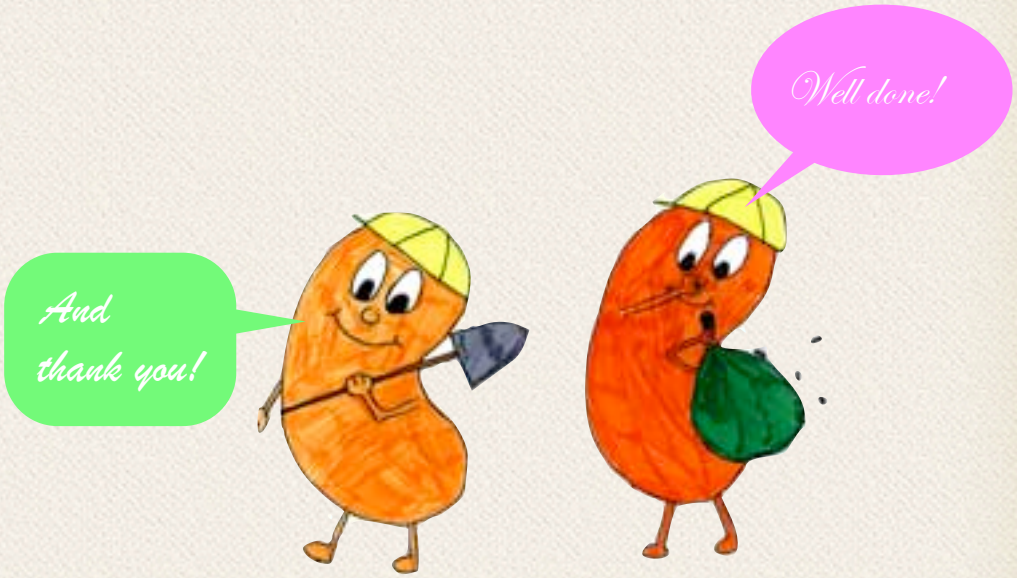
a)**Ureter**
b)**Collecting tubule**
c)**Glomerulus**
d)**Proximal convoluted tubule**

3- Which one of the following best describes the adult kidney?

a)**An additional number of nephrons develops after birth**
b)**lies inferior to the adrenal glands**
c)**Lobulations are visible**
d)**Is supplied by branches of the common iliac arteries**

3- Failure of one kidney to develop is due to..

a)**Absence of one ureteric bud**
b)**Malrotation during development**
c)**Failure of kidney to ascend**
d)**Development of two ureteric buds**



Answers: C-D-B-A