

# **Normal and abnormal development of the urogenital tract**

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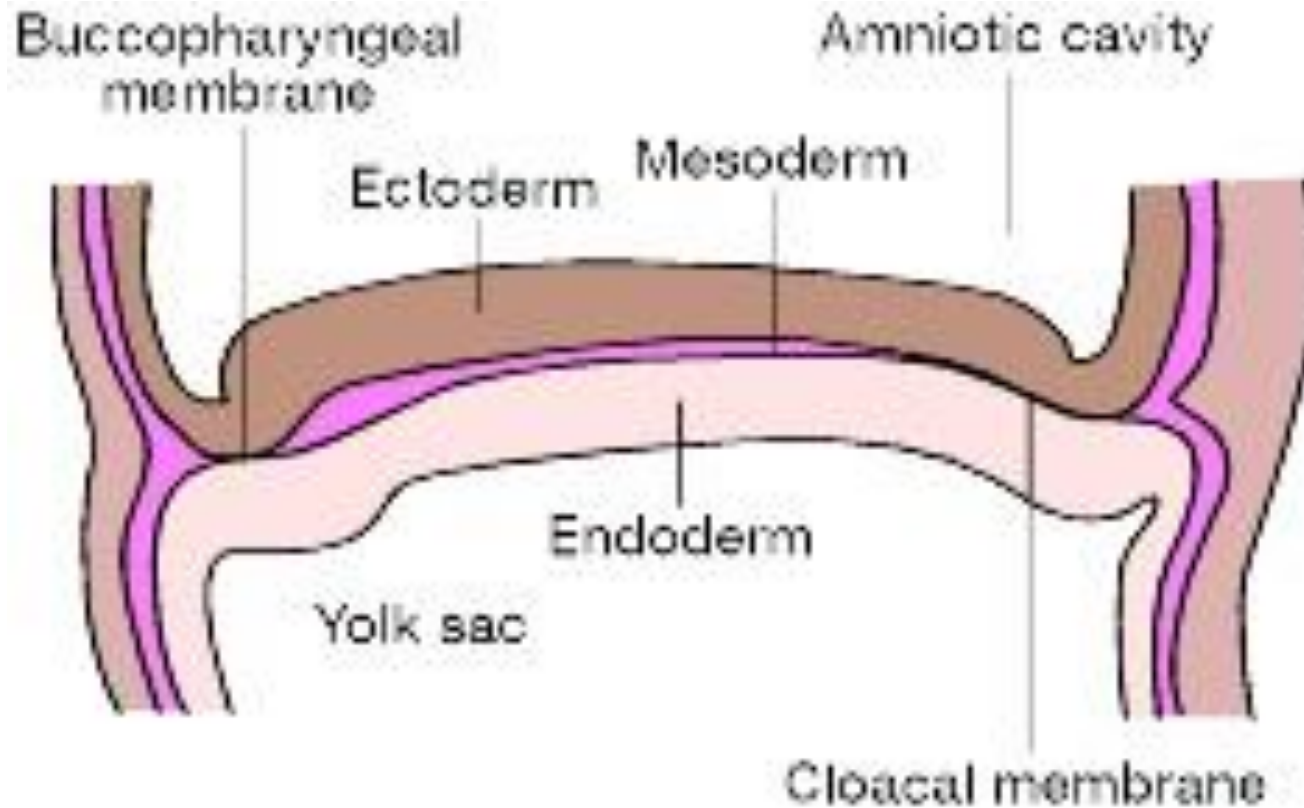
## ***Normal development of the urogenital tract***

- **anatomy of development**
- **regulating genes involved in the development of the urogenital tract**
- **research of the congenital anomalies**
- **to get known and understand the embiogenesis**
- **stopped development in mice by driven „nil“ mutation**

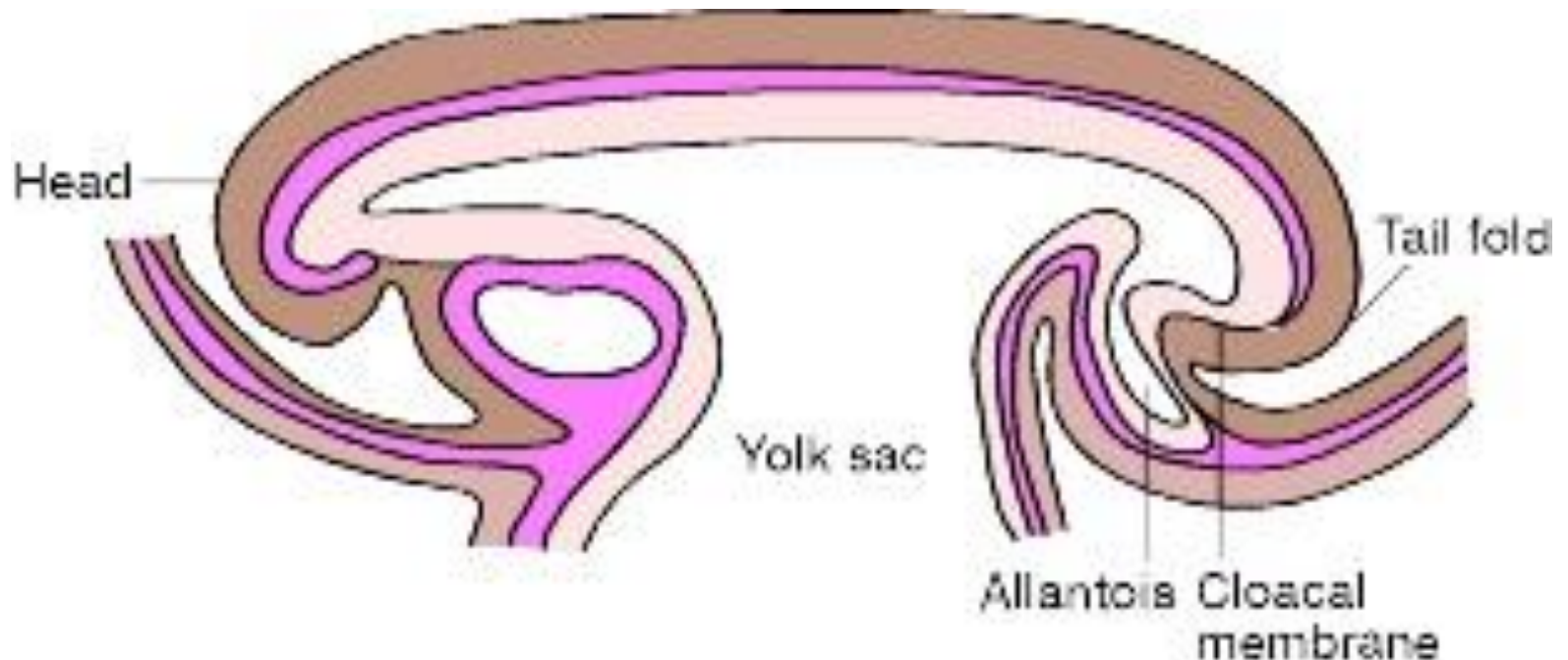
## **Beginning of life and role of the urological tract**

- **intrauterine life (human fertilization)**
- **human gestation (fusion of spermatozoon, oocyta)**
- **development of organs and form of the foetus (10 weeks)**
- **expansion of the embryo, enlargement, maturation(40<sup>th</sup> week)**
- **role of the upper urinary tract**
  - **regulate secretion of nitrogenous waste products**
  - **homeostasis of water and electrolytes**
  - **acid base balance**
  - **the production of hormones**

## **Human embryonic disc**



# **Development of head and buccopharyngeal, tail and cloacal membrane**



## **Embriogenesis of the kidney (nephrogenesis) I.**

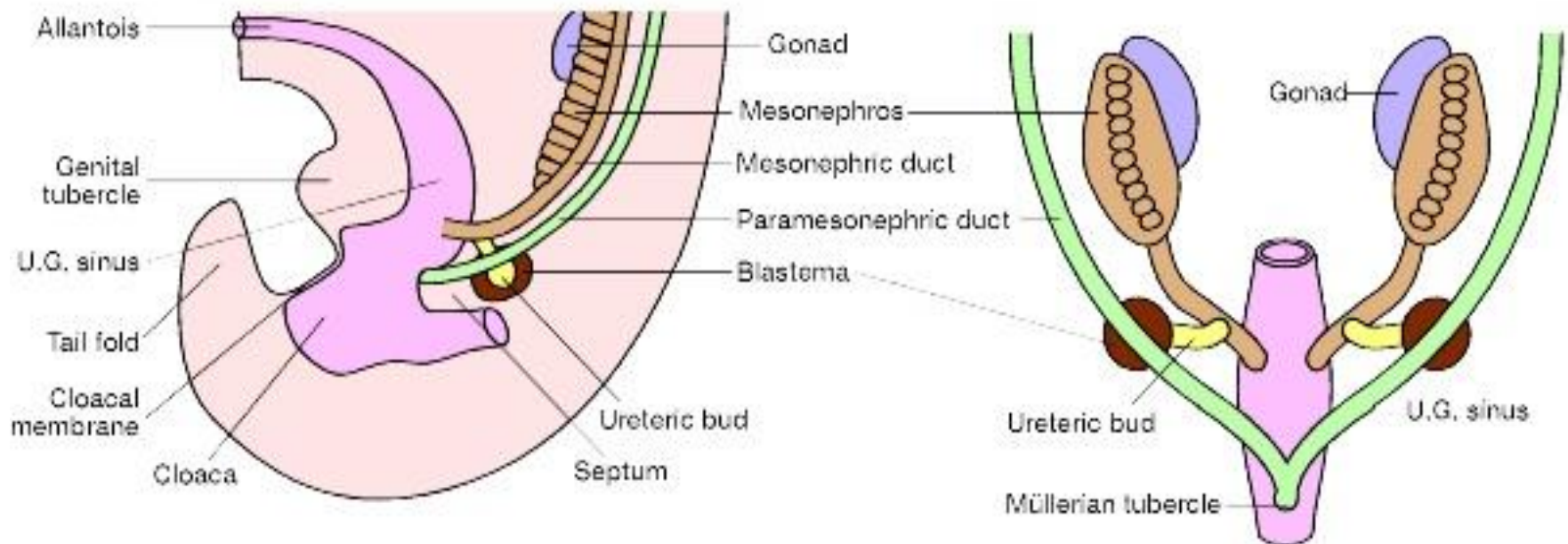
- **three paired 'kidneys' in the mammalian embryo: (intermediate mesoderm of the dorsal body wall) arises sequentially**
- **the pronephros (22<sup>nd</sup> day)**
- **the pronephros and mesonephros degenerate during mammalian fetal life**
- **whilst the metanephros develops into the adult kidney**
- **in contrast, the pronephros: functioning kidney in the adult hagfish**
- **in some amphibians the mesonephros is the excretory organ in adult lampreys, some fishes and amphibians**

**AGENESIA, HYPOPLASIA RENIS**

## **Embriogenesis of the kidney (nephrogenesis) II.**

- **26<sup>th</sup> day pronephric duct arises and elongates (caudally) and reaches cloacal membrane arises**
- **this duct is renamed as Wolffian duct**
- **at 24<sup>th</sup> day of gestation mesonephros develops**
- **mesonephric tubules develops with „mesenchymal to epithel“ transformation (40 tubules); glomeruli, proximal and distal collecting tubules (up to 6-10. weeks)**
- **cranial part (epigenital), caudal part (paragenital)**

## **5<sup>th</sup> week**





## **Embriogenesis of the kidney (nephrogenesis) III.**

- **metanephros (consist of only 2 cell types)**
- **ureteric bud (epithelial cells)**
- **metanephric mesenchym (mesenchymal cells)**
- **at 28<sup>th</sup> day ureteric bud arises (Wolffian duct's postero-medial aspect of mesonephric duct as a diverticulum)**
- **32<sup>nd</sup> day reaches the metanephric blastema (elongates and tip)**
- **series of reciprocal interactions to branch multiple times**

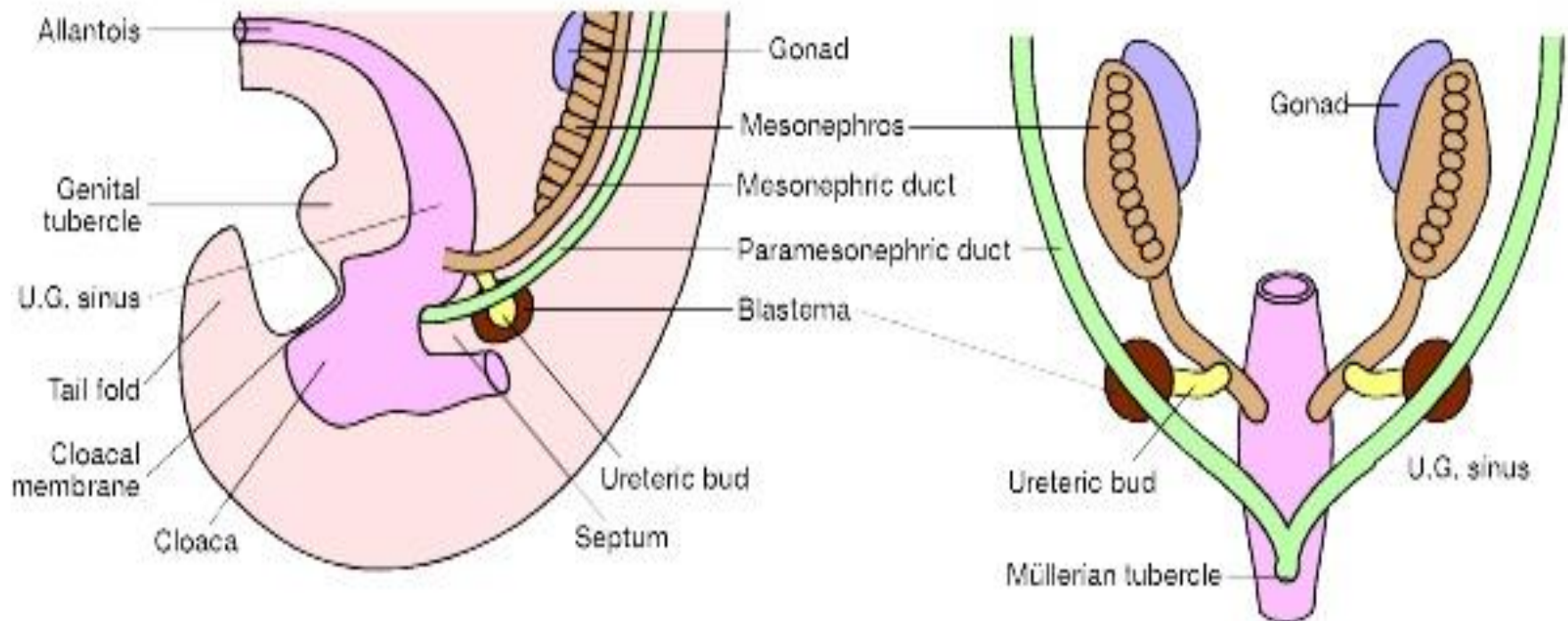
**HYPOPLASIA RENIS, REN MULTICYSTICA**

## **Embriogenesis of the kidney (nephrogenesis) IV.**

- **induction of the ureteric bud: 4 major calyces, 6-8 generation fuse to form minor calyces, final 8 definitive collecting duct system**
- **mesenchymal induction: proximal convoluted tubes, loop of Henle, distal convoluted tubes (glomerulogenesis: 8-9. week)**
- **nephrogenesis 40. week**
- **angio-, vasculogenesis (arteria iliaca)**

**HYPOPLASIA, REN DEGENERATIONEM MULTICYSTICA  
VASCULARIS ATYPIA**

## **5. hét**

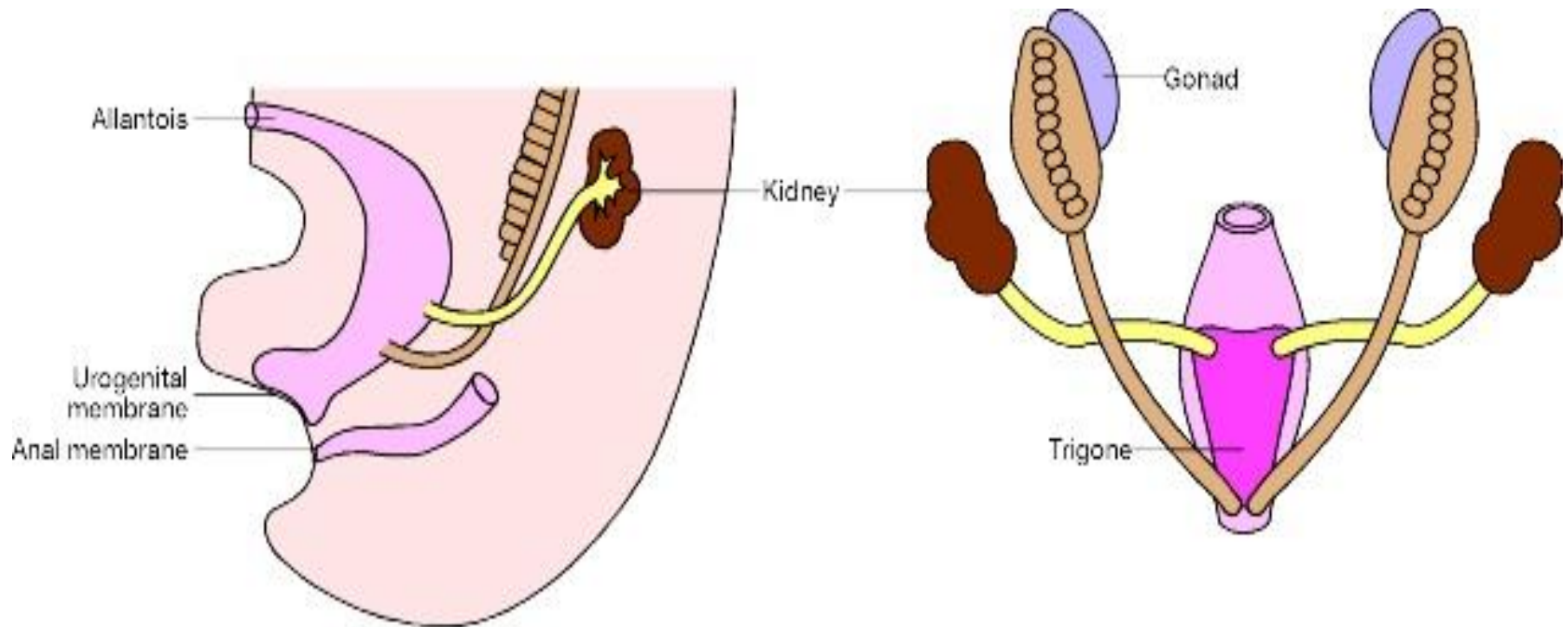


## **Ascend of the kidney and filtration**

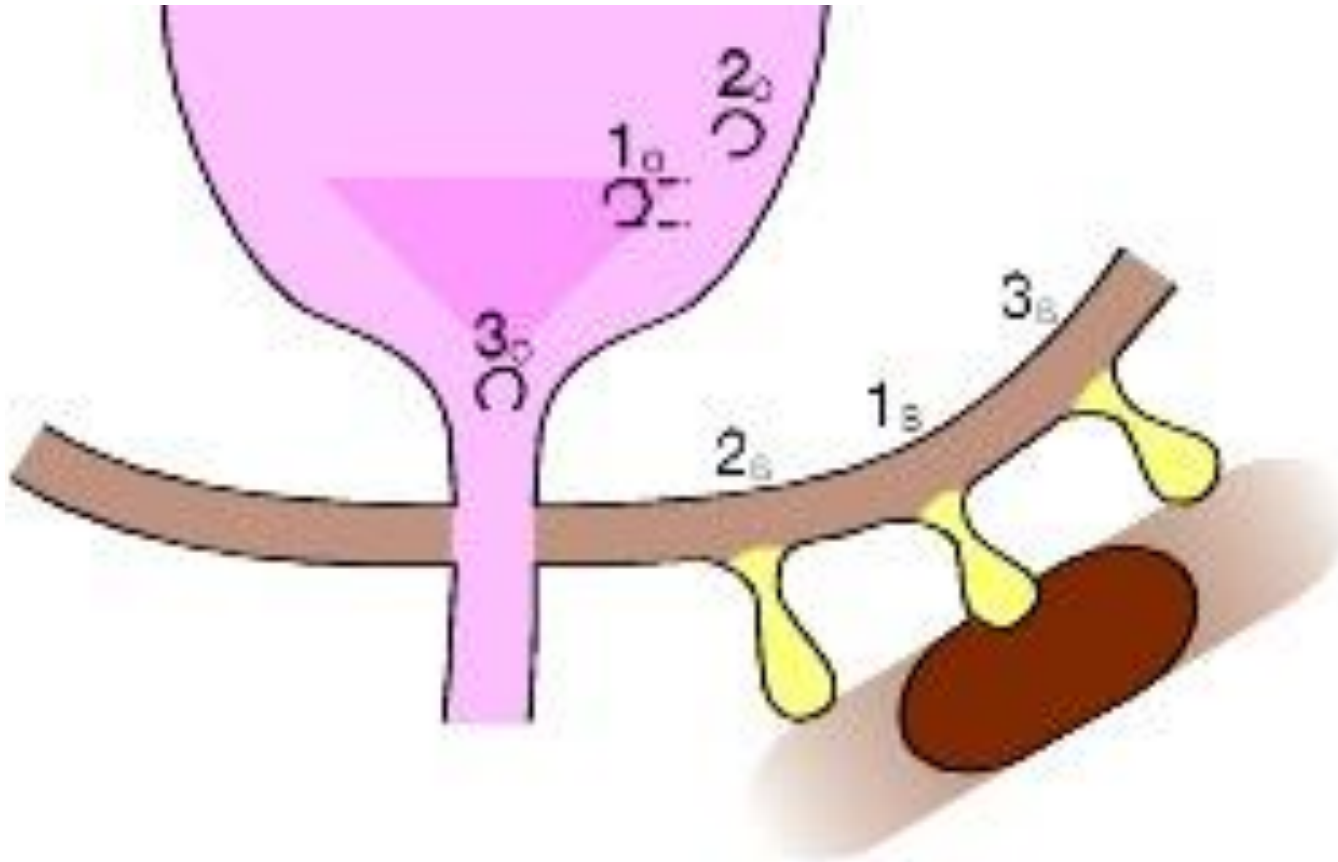
- **lobulated kidney ascends from its pelvic position during the 6-9. weeks**
- **blood supply from the aorta (lower branches degenerates)**
- **pelvic kidney faces anteriorly and rotates medially**
- **foetal urine is produced from the 10th week (plasma filtrations little modified)**
- **tubular function develops after the 14<sup>th</sup> week**
- **the foetal kidneys provide over 90% of the amniotic fluid (adequate volume to move freely, lung and skeletal development)**

**UNROTATED KIDNEY, DYSTOPIC KIDNEY, OLIGOHYDRAMNION**

## **8<sup>th</sup> week**

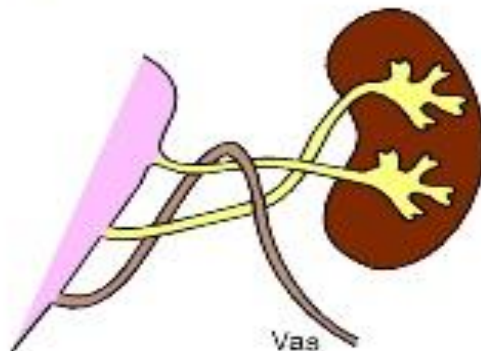
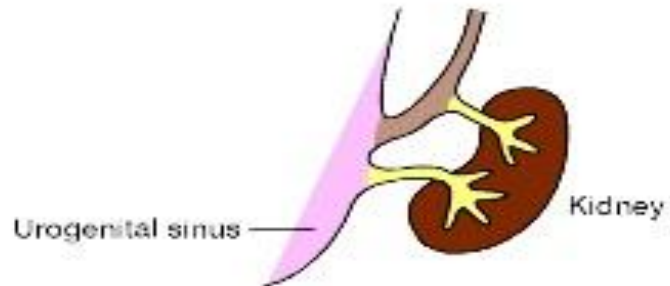
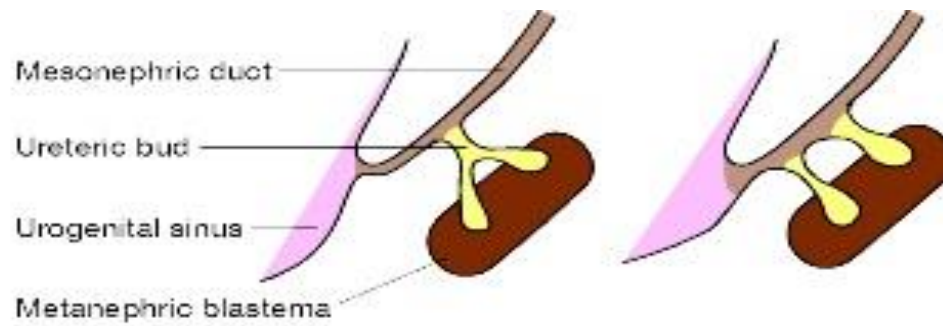


## **Stephen- Mackie rule**



**HYPOPLASIA v. DYSPLASIA**

P.M. Cuckow, P. Nyirády: Embryology and Pathophysiology of the Kidneys and Urinary Tracts in Pediatric Urology, W.B. Saunders, 2001.



**Weigert-**

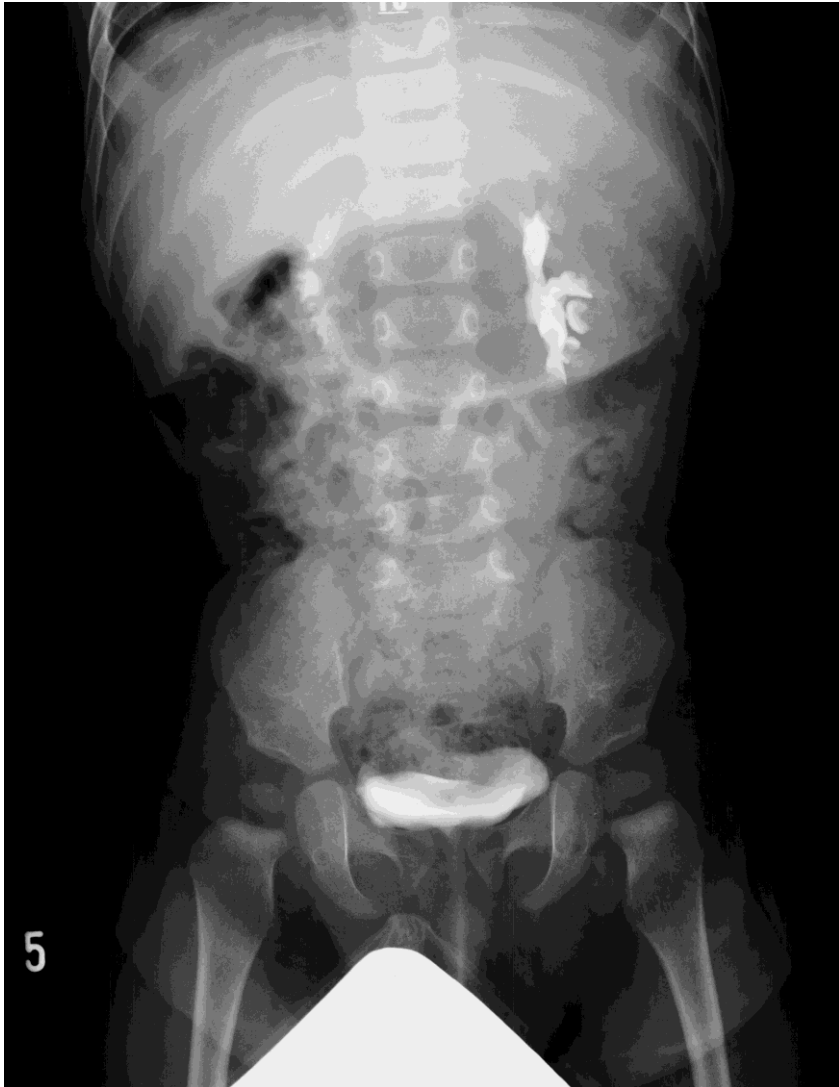
**Meyer rule**

**REN DUPLEX**

P.M. Cuckow, P. Nyirády: Embryology and Pathophysiology of the Kidneys and Urinary Tracts  
in Pediatric Urology, W.B. Saunders, 2001.



# Hypoplasia

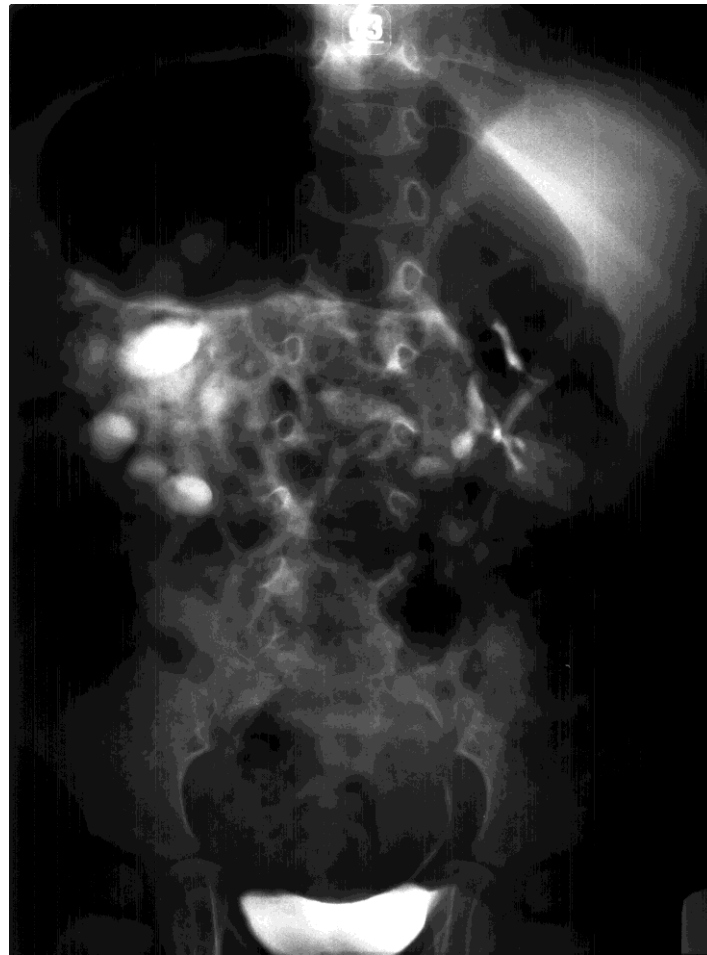


# Ren dystopicus sacralis

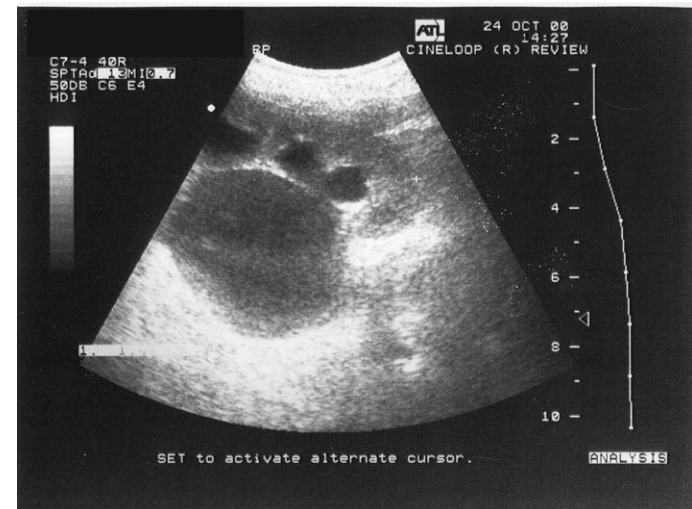




# Ren arcuatus



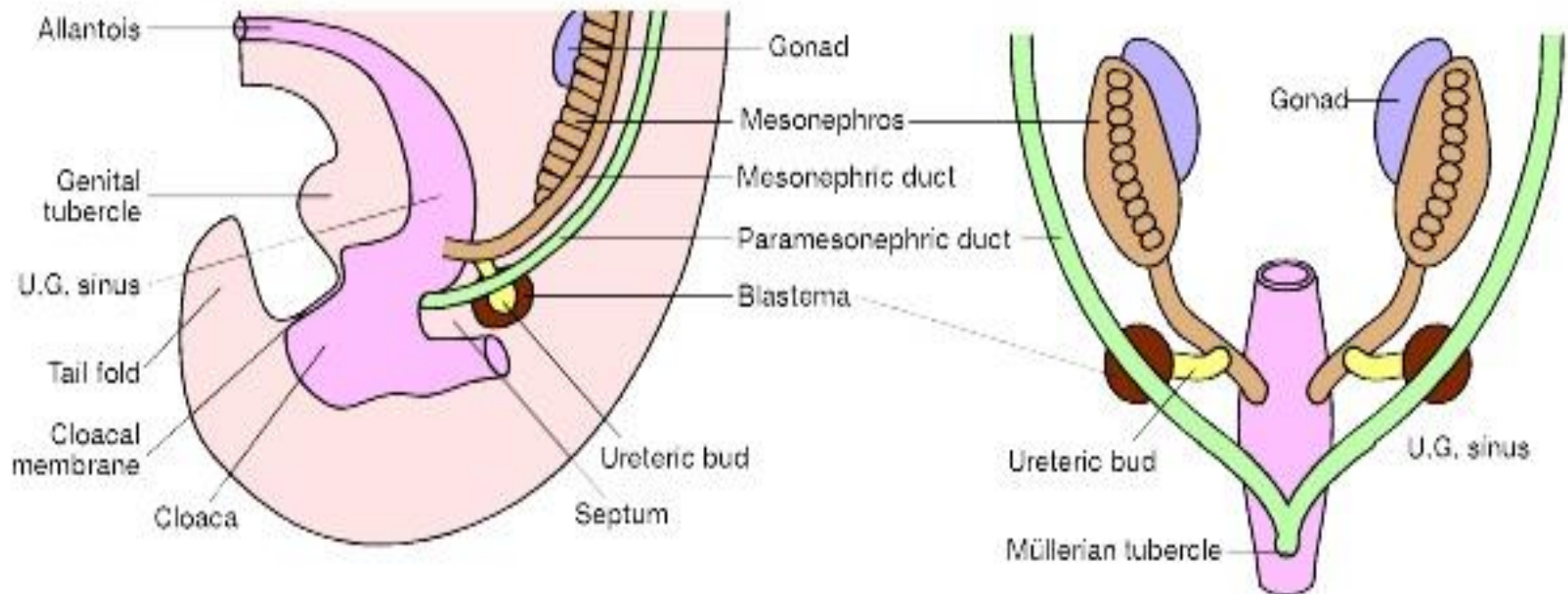
# Pyeloureteral obstruction Praehydronephrosis



## **Normal development of the urinary bladder I.**

- ingrowth of mesoderm point of confluence of the allantois and the hindgut
- partitioning of the cloaca: (around 28th day) by an advancing septum
- septum aided by the in-growth of lateral Rathke's folds
- cloaca is divided into an anterior primitive urogenital sinus that receives the mesonephric ducts, and a posterior rectum
- septation is completed urorectal septum reaches cloacal membrane (6.w)
- urogenital membrane breaks down (7th week)
- continuity between the developing urinary tract and the amniotic cavity.
- primitive urogenital sinus: between the allantois and the mesonephric ducts called the vesicourethral canal form the definitive bladder.

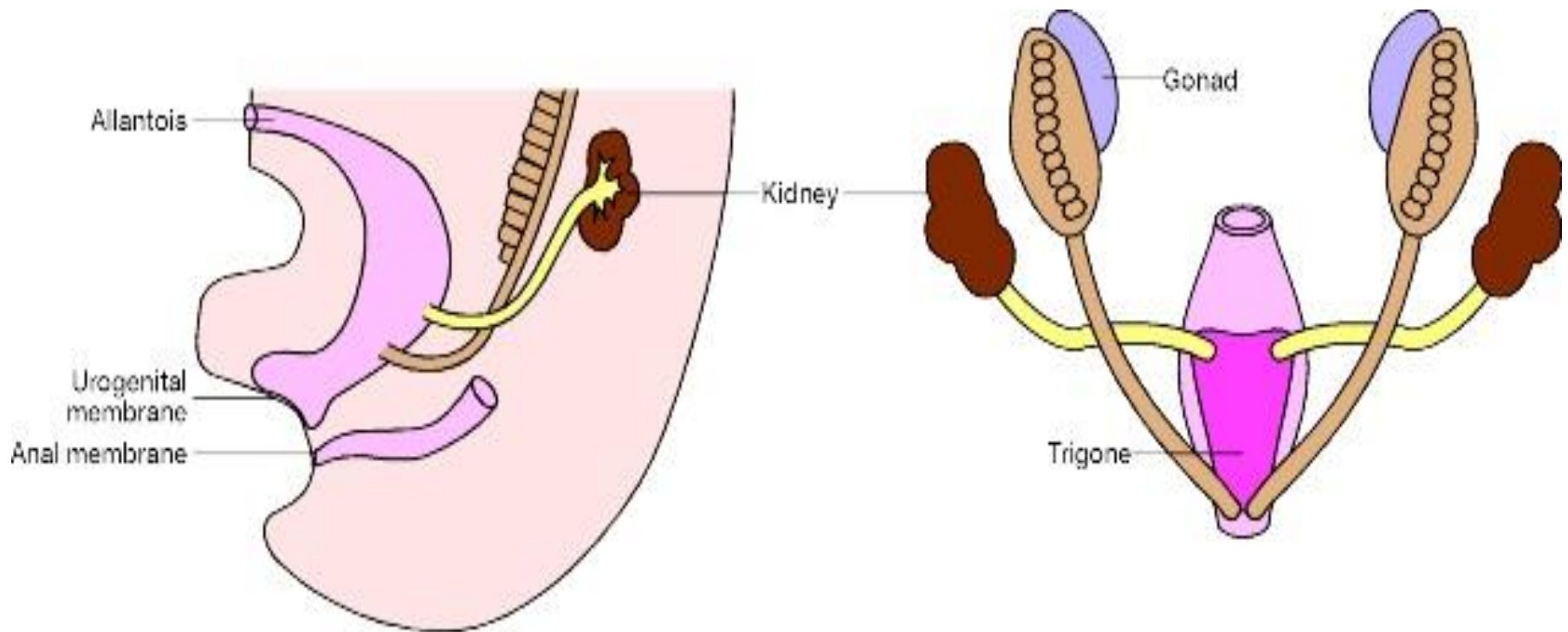
## **5<sup>th</sup> week**



## **Normal development of the urinary bladder II.**

- inductive interactions between endoderm of the urogenital sinus
- endoderma: urothelium
- mesenchyma: detrusor smooth muscle and adventitia
- Growth of the anterior abdominal wall between the allantois and urogenital membrane is accompanied by an increase in size and capacity
- at 13<sup>th</sup> week circular and longitudinal muscles are visible on trigone
- at 16<sup>th</sup> week: continencia? (inner and outer longitudinal and circular detrusor smooth muscle)
- 21<sup>st</sup> week urothelium is developed

## **8<sup>th</sup> week**



## **Development of the ureterovesical junction**

- ureteric orifices are incorporated into the developing bladder
- become separated from the mesonephric duct orifices
- further incorporation of more proximal mesonephric ducts the ureteric orifices move superolaterally relative to the mesonephric duct orifices
- These stay close to the midline and descend into the developing posterior urethra
- 9<sup>th</sup> week smooth muscle of the ureters develop (urine production)
- 18<sup>th</sup> week PU and UV obstruction



# Ureterocele



# VUR



## **Malformations of the urinary bladder**

**US:** bladder 11-12nd week      **Dg.:** (extrophia 20th week)

**Agnesia:** hydronephr., dysplasia

**Hypoplasia:**

**Megacysta - megaureter**                      **VUR**

**Duplex:**                      obstruction?

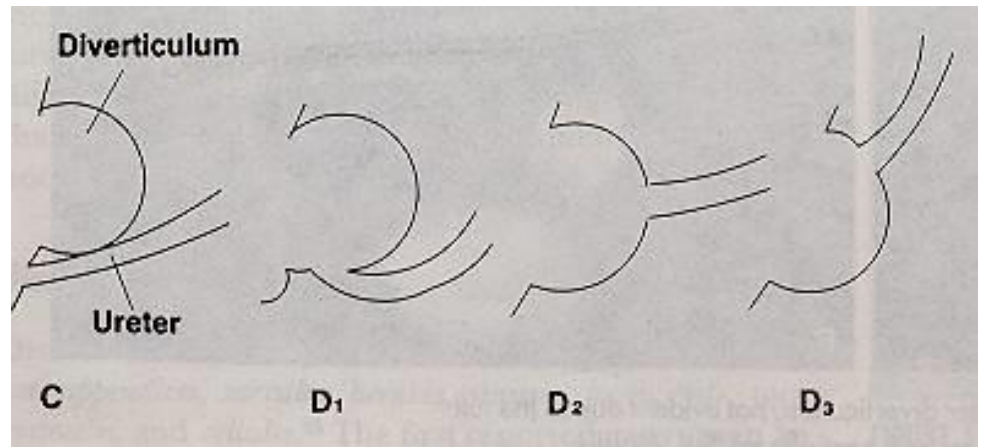
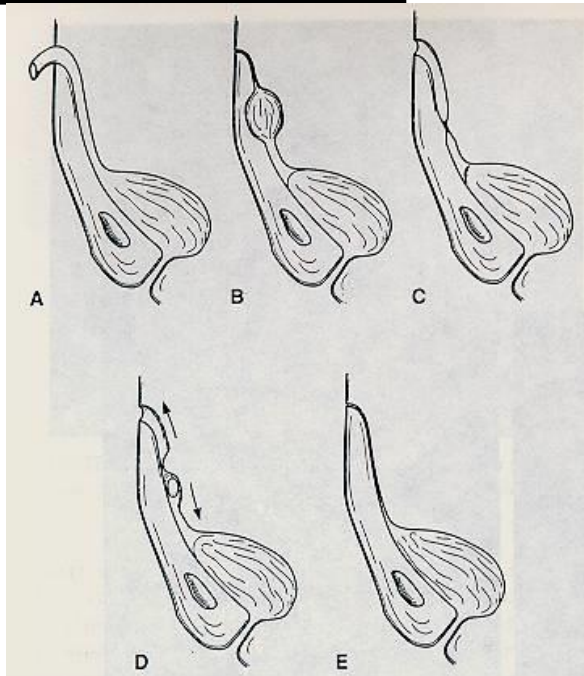
**complete:**                      separate urethra (penis, uterus, vagina)

**partial:**                      1 urethra

## Malformations of the urinary bladder II.

**Urachus:** opened, cysta, sinus, diverticulum.

**Diverticulum:** obstruction? (valve)

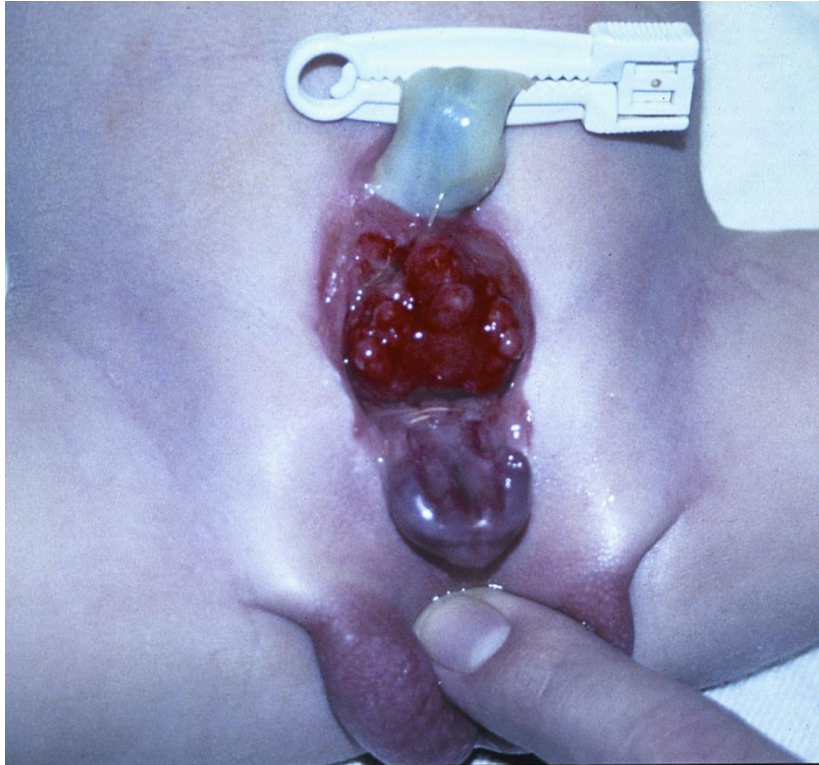


## **Malformations of the urinary bladder III.**

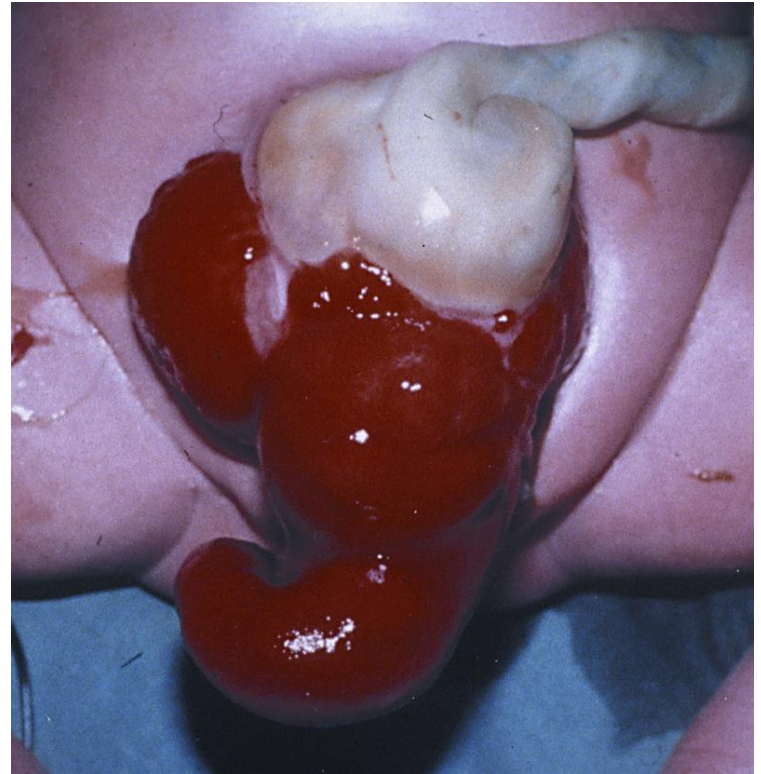
**Extrophia:** epispadiasis      complete reconstruction.  
symphysealysis  
fecal incontineence  
tersticular retention



# **Exstrophia vesicae urinariae**



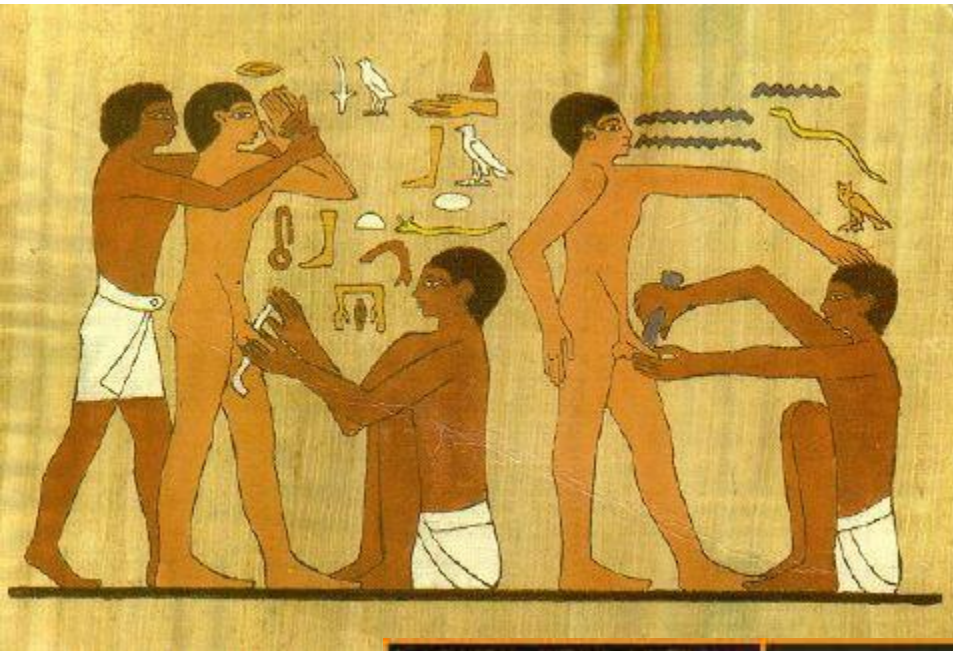
bladder exstrophia



Cloacal exstrophia



# **Development of the external male genitals**



**Circumcision piramis from  
Sakara (b.c. around 2200)**



**Medici Katalin, II. Henrik és Diana de Poietiers**

# **Chordee**

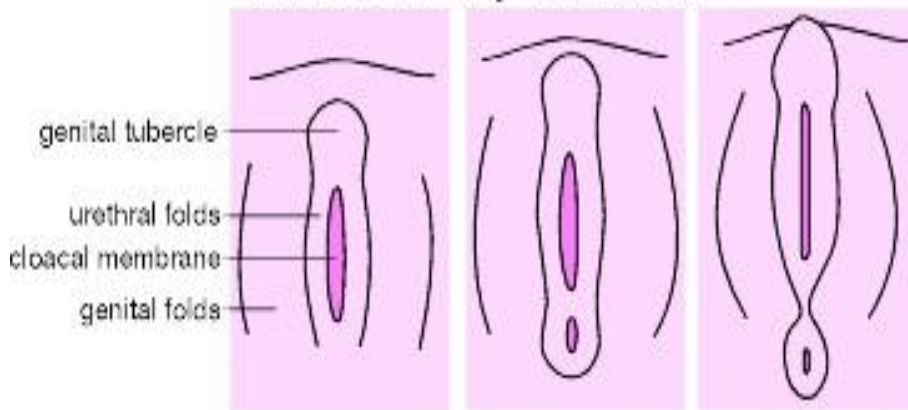
- Galen (130-199) doctor of the gladiators
- „Hypospadias”: infertility, curvature of the penis (1500 years)
- Oribasus (325-403) penile curvature sexual intercourse is impossible
- Mettauer (1842) U.S. : „succesion of subcutaneous incisions until the organ is liberated” - 1967 D.R. Smith

# **Urethral reconstruction**

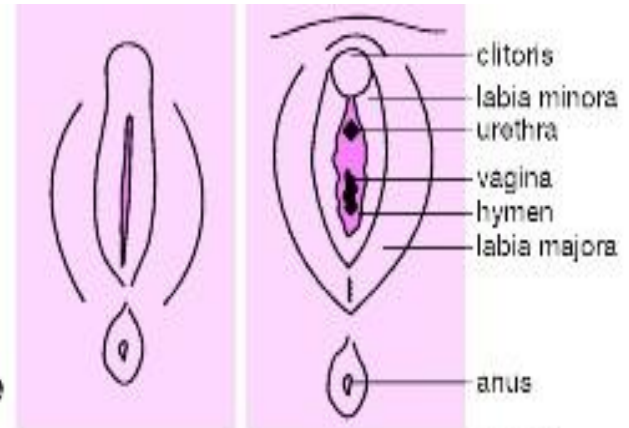
- Antyl (I. sz.) és Paul of Aegina (625-690) amputation
- (1000 years)
- more than 300 methods

# **Development of the external male genitals**

6th week Early 7th week

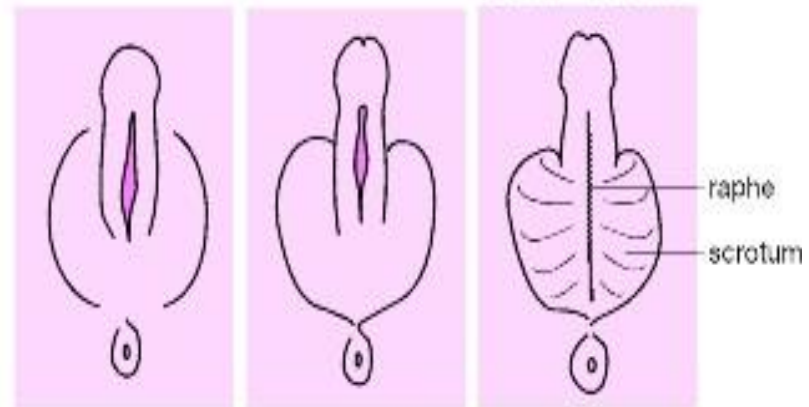


Female



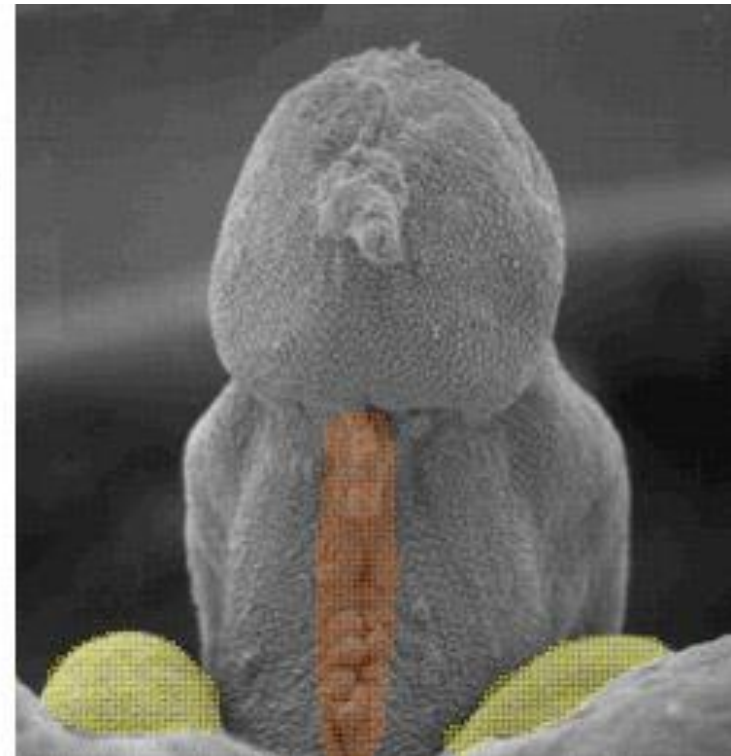
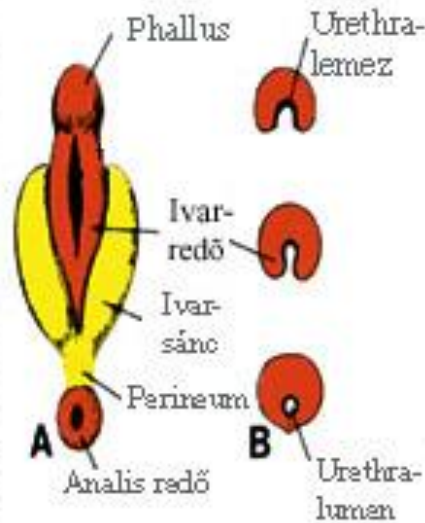
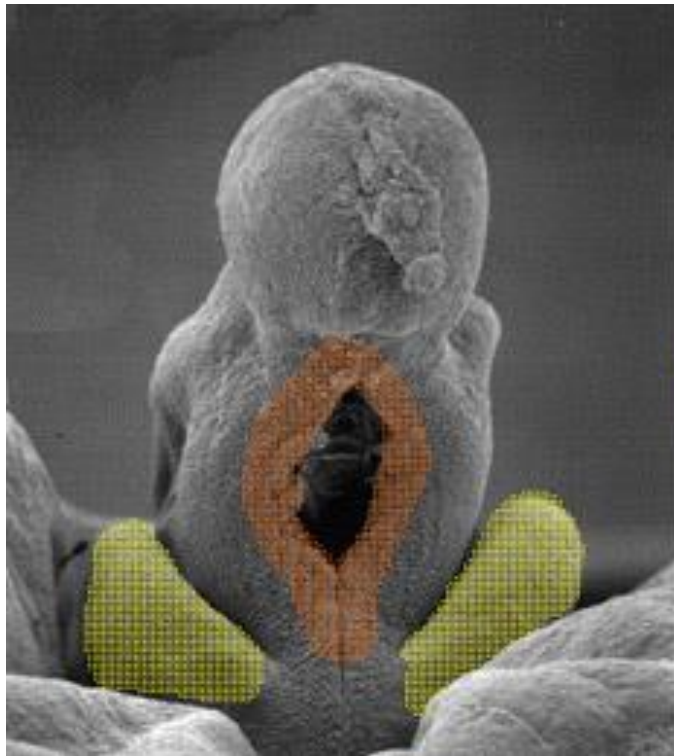
20th week

Male

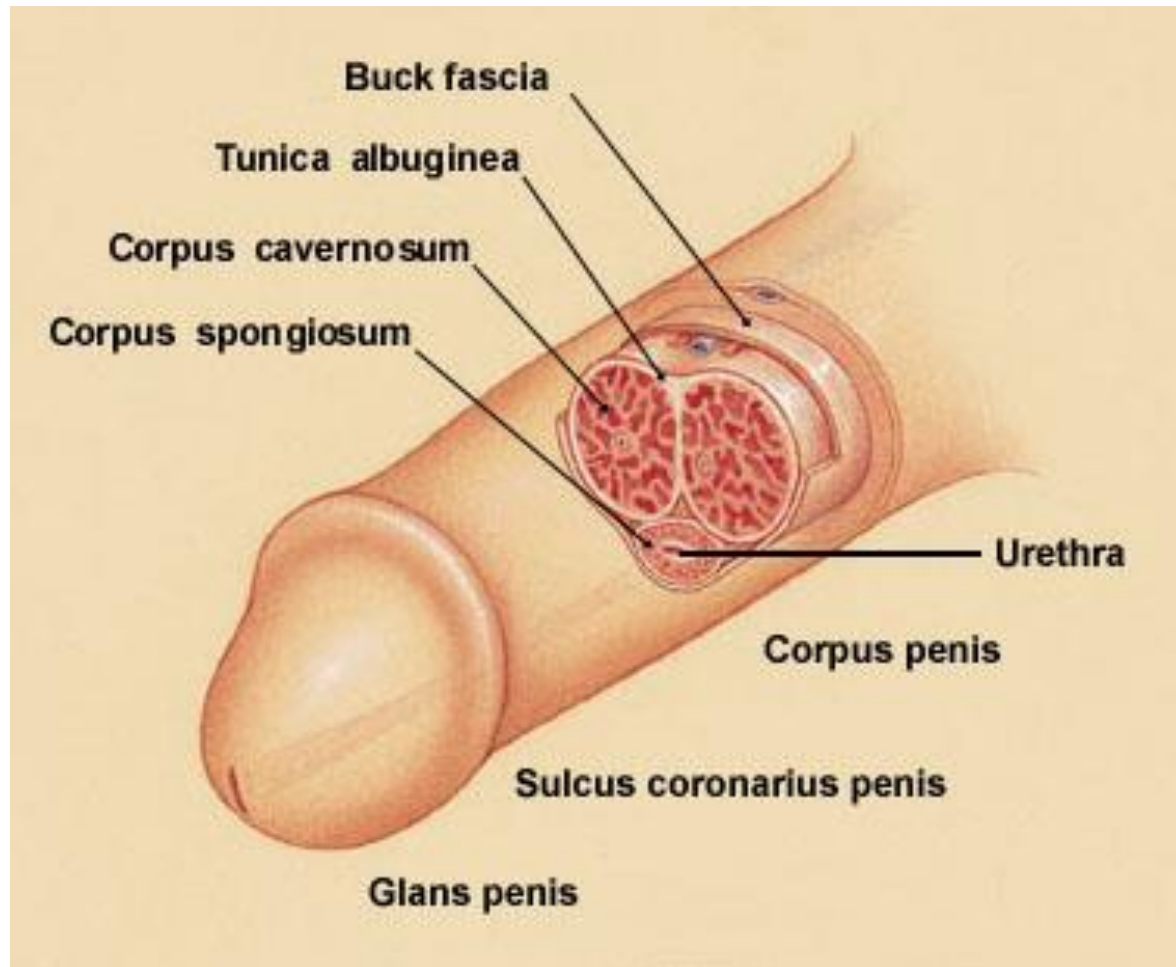




# *Development of the penis*



# **Anatomy of the normal penis**



# Penile congenital anomalies

**Meatal stenosis:** obstruction: acute indication for operation

**Frenulum breve:**

**Phimosis:** - obstruction

- after the age of 2 years, opus

**Penile curvatura:**

hypospadiasis sine hypospadia

Prostaglandin probe

fascia-dyspl.

chordectomia

corporoplastica

short urethra?

# Urethral problems II.

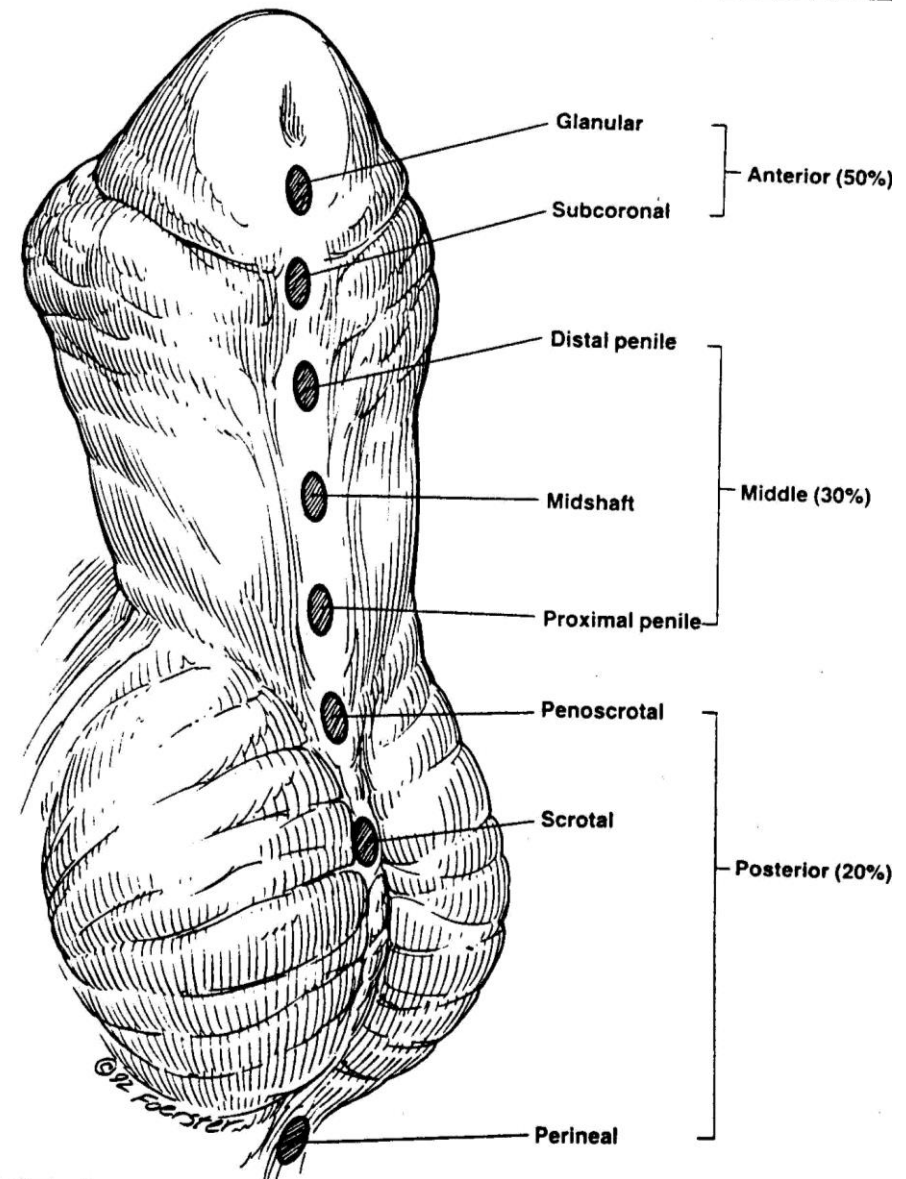
## Hypospadias penis

- place of the meatus
- chordee (adolescent)
- estetical looking

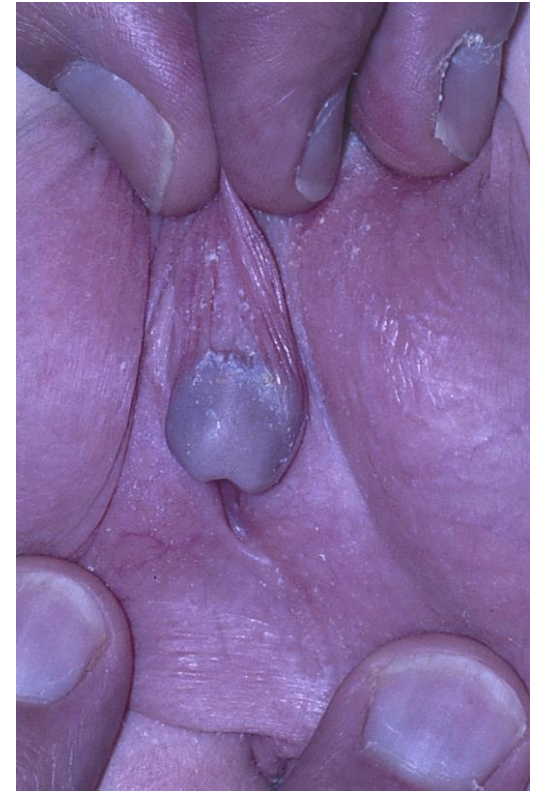
Acute operation: meatal  
stenosis!

Dg.: curvature

Time: 1/2 - 3 years



# *Hypospadias*





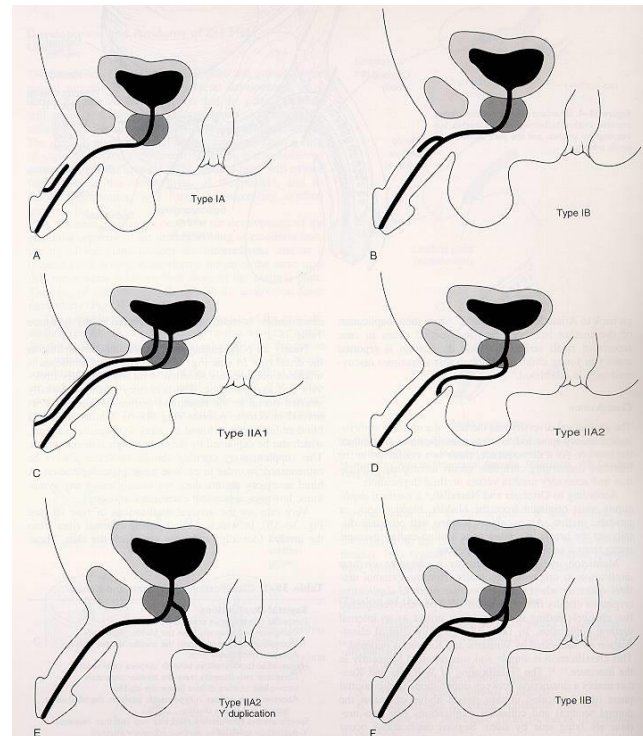
Duplex urethra

Megalourethra: no corpus spongiosa

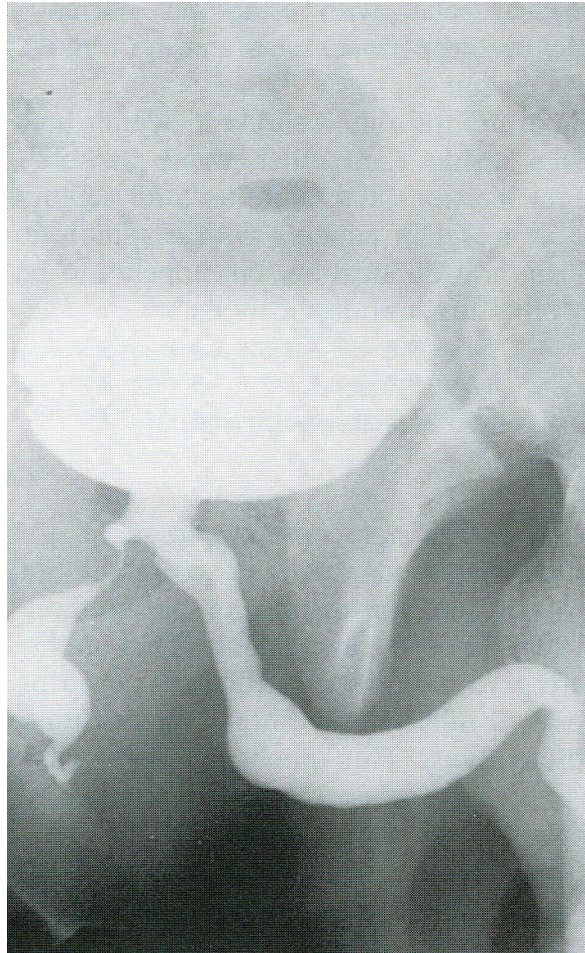
Paraurethr. cysta:

Cowper, utriculus prost.

Endoscopic incision



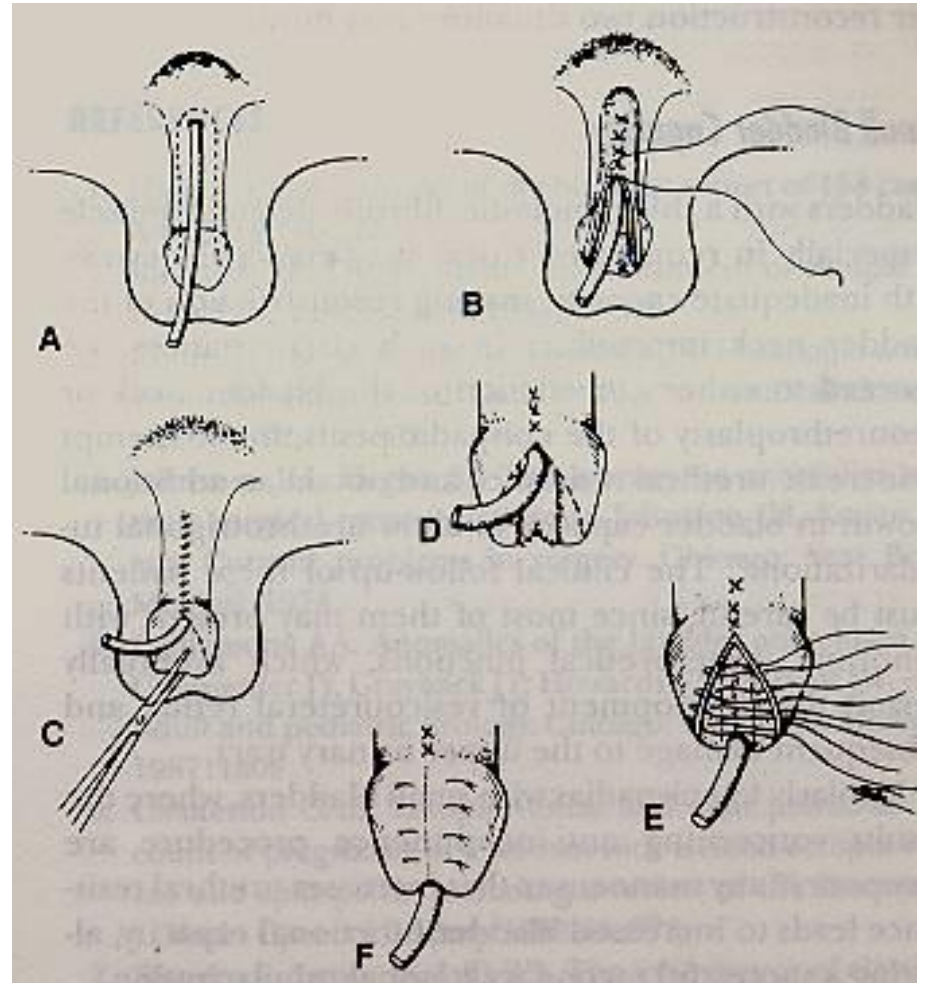
# **Urethra duplex**



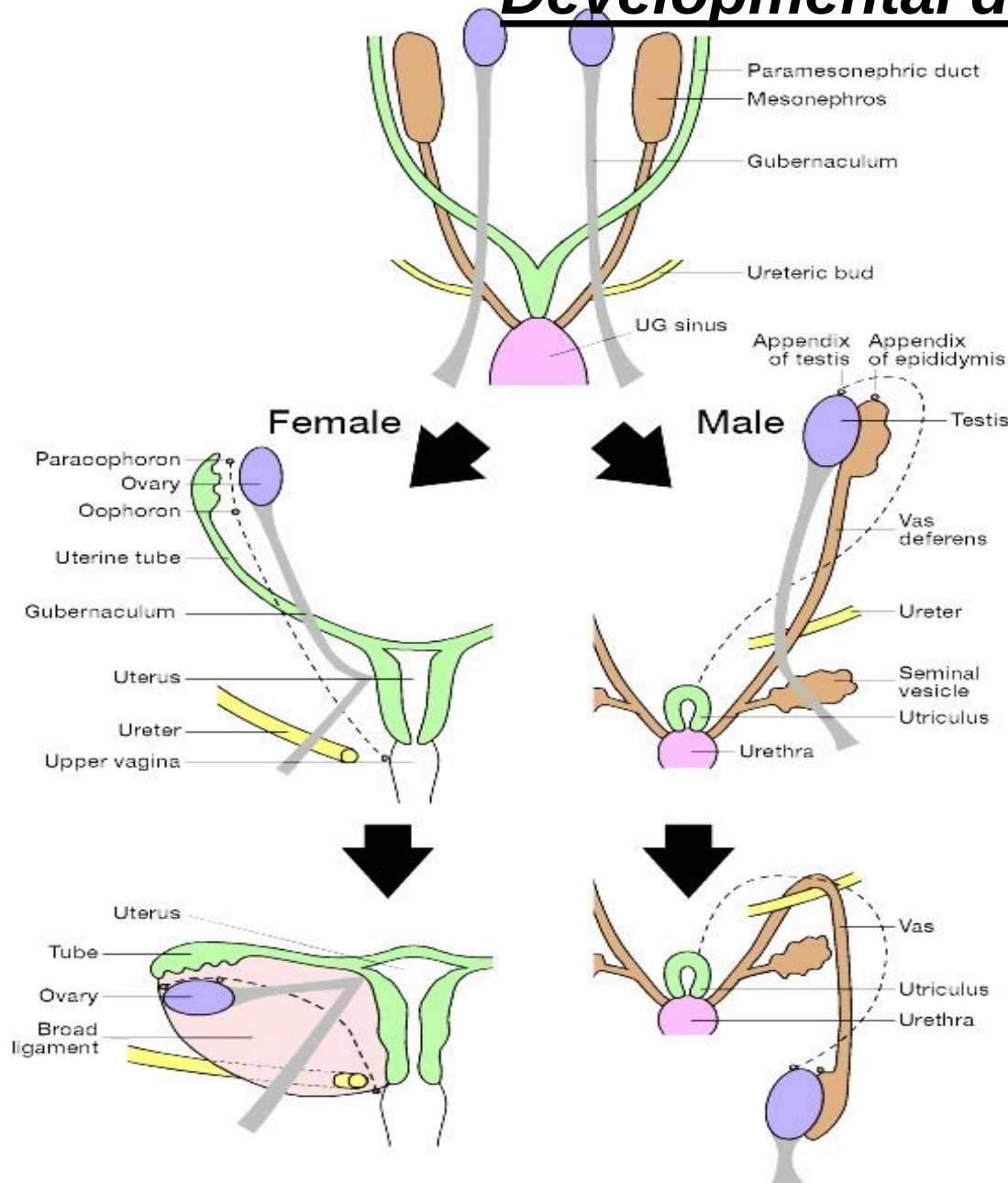


# Epispadias: gland episp.

1:100.000



# **Developmental disorder of the testes I.**

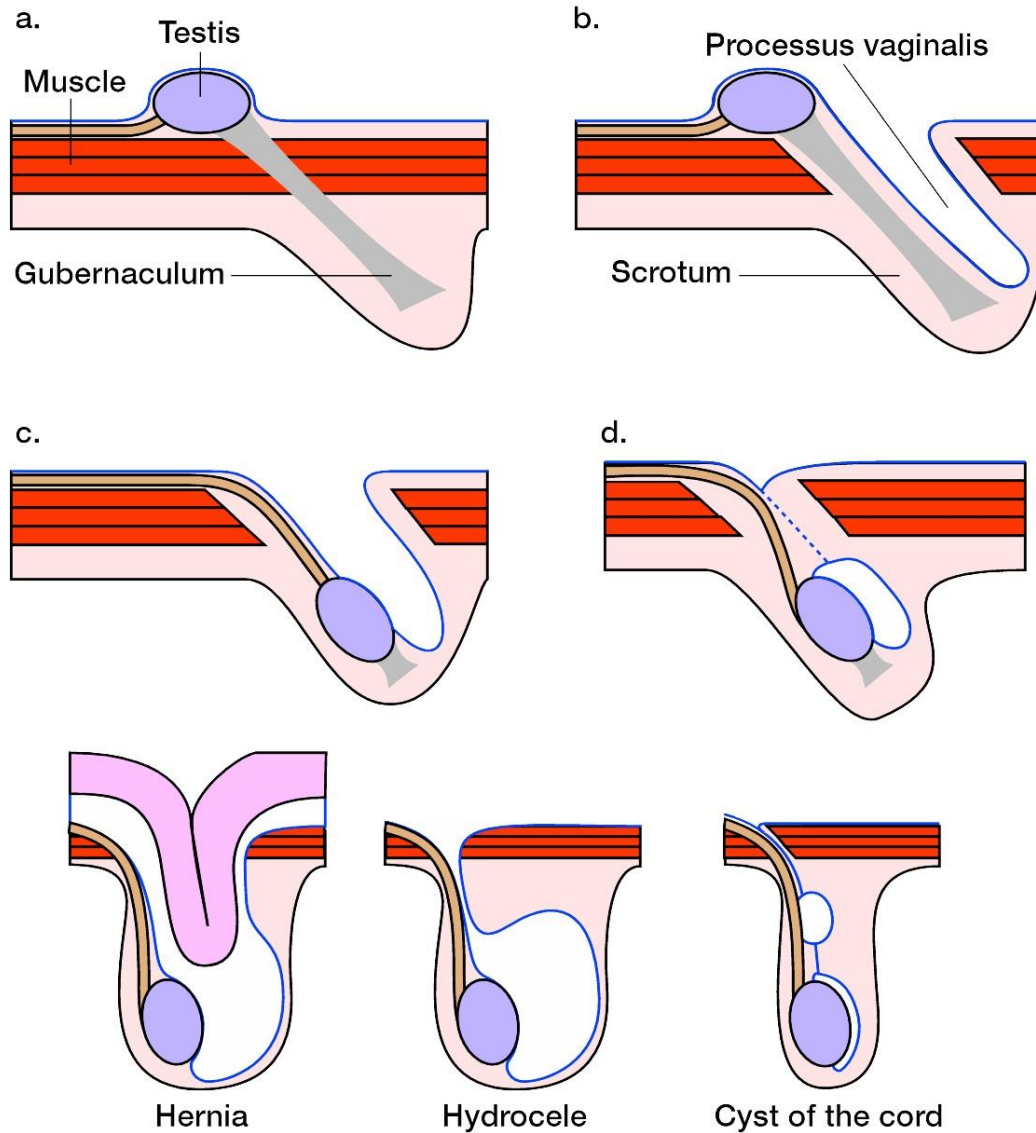


- agenesis
- aplasia
- hypoplasia
- retentio testis

intraabdominal  
abdominoinguin.  
inguinal  
inguinoscrotal  
ingahere

- fusional disorder of testis and epididymis

## **Developmental disorder of the testes II.**





**THANK YOU FOR YOUR  
ATTENTION!**

