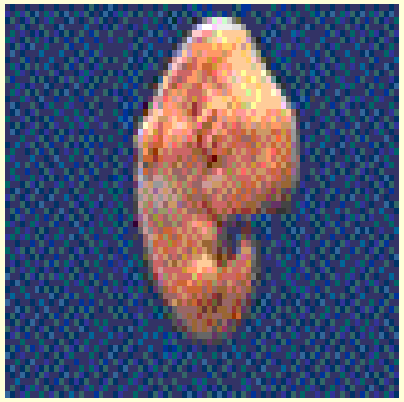
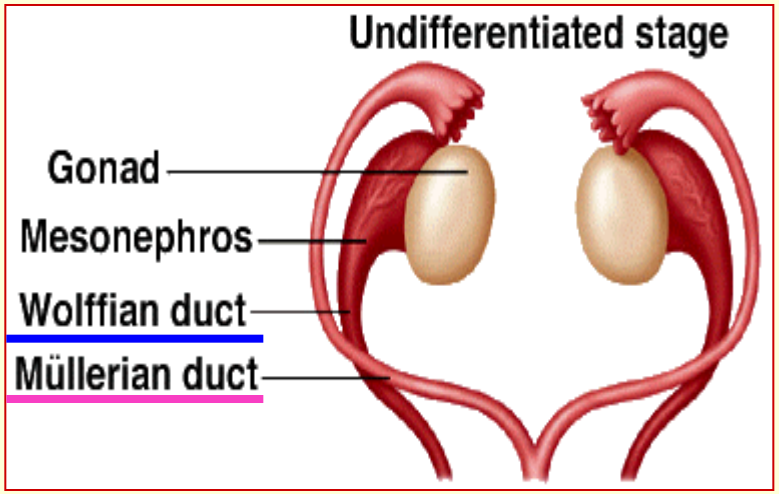


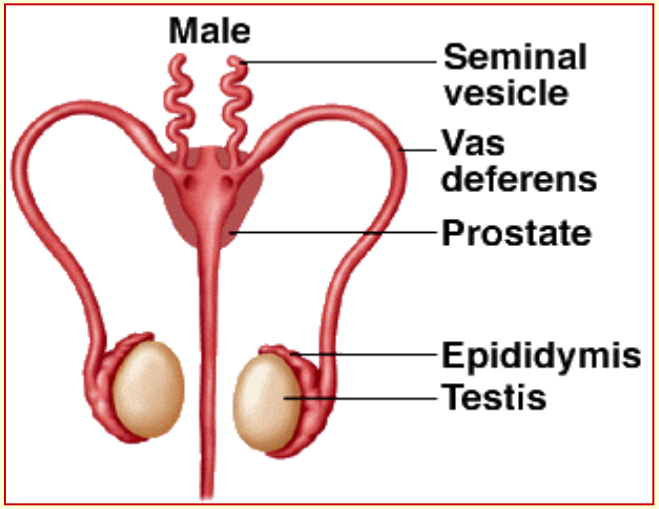
Embryology /organogenesis/

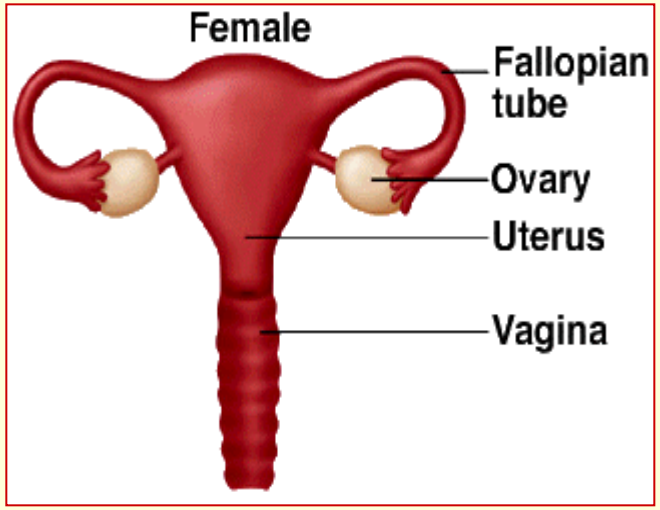
Week 4

Development and teratology of reproductive system.

Male or female sex is determined by spermatozoon Y in the moment of fertilization







SRY gene, on the short arm of the Y chromosome, initiates male sexual differentiation.

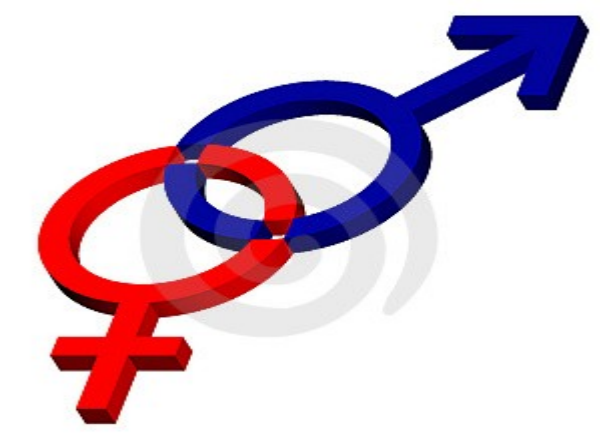
- The **SRY** initiates transformation of indifferent gonads to form **testes**, which produce hormones supporting development of male reproductive organs.

- Developed testes produce:

- **testosterone** (T) - stimulates the Wolffian ducts development (*epididymis and deferent ducts*)

and

- **anti-Müllerian hormone** (AMH) - suppresses the Mullerian ducts development *(oviduct, uterus, and upper vagina).*



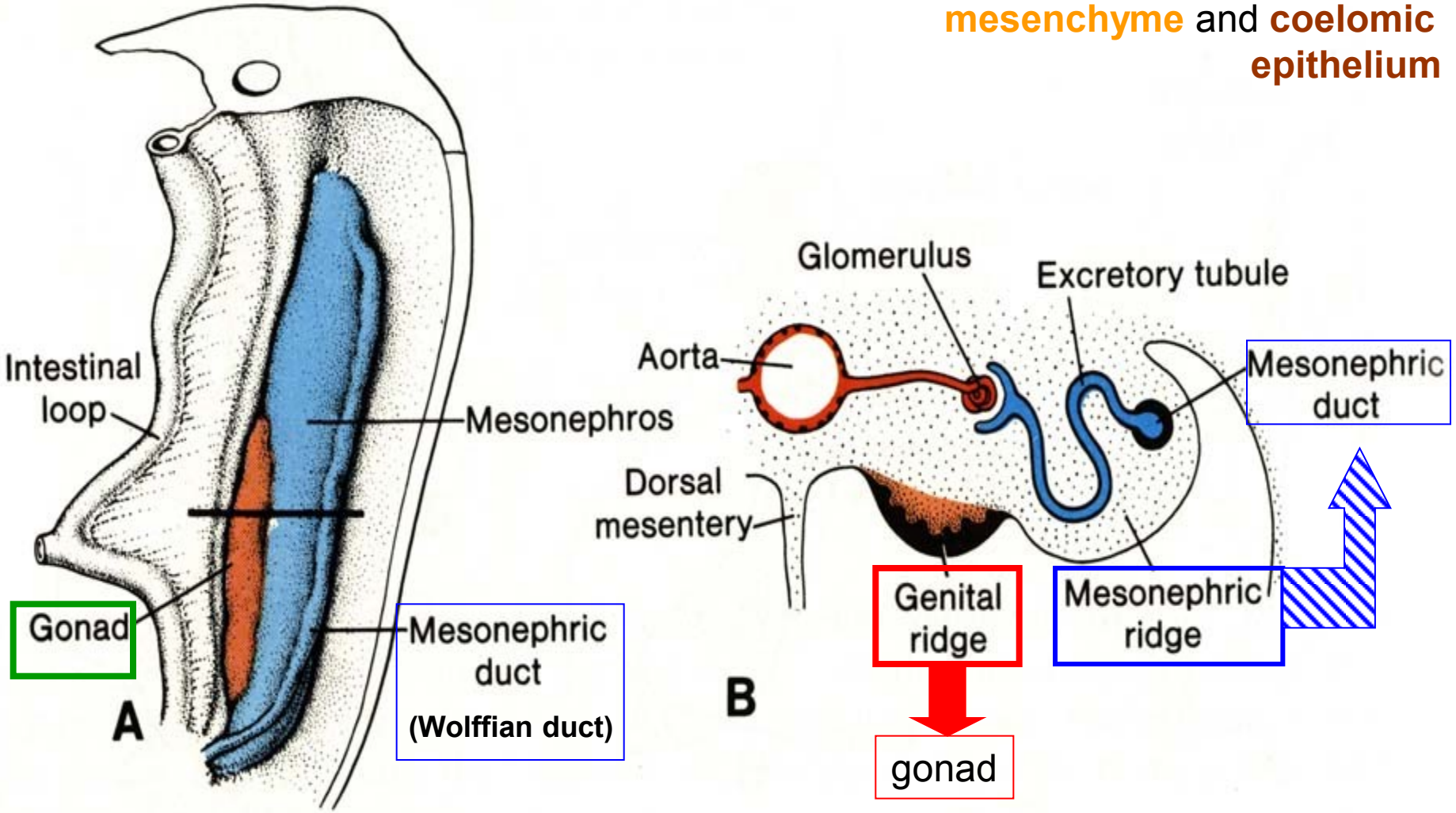
- Indifferent stage – until the 7th week
- Differentiated stage

1) Development of gonads
2) Development of reproductive passages
3) Development of external genitalia

Development of gonads

Dorsal wall of body: urogenital ridge

- **mesonephric ridge** (laterally)
- **genital ridge** (medially), consisting of
  - **mesenchyme** and **coelomic epithelium**

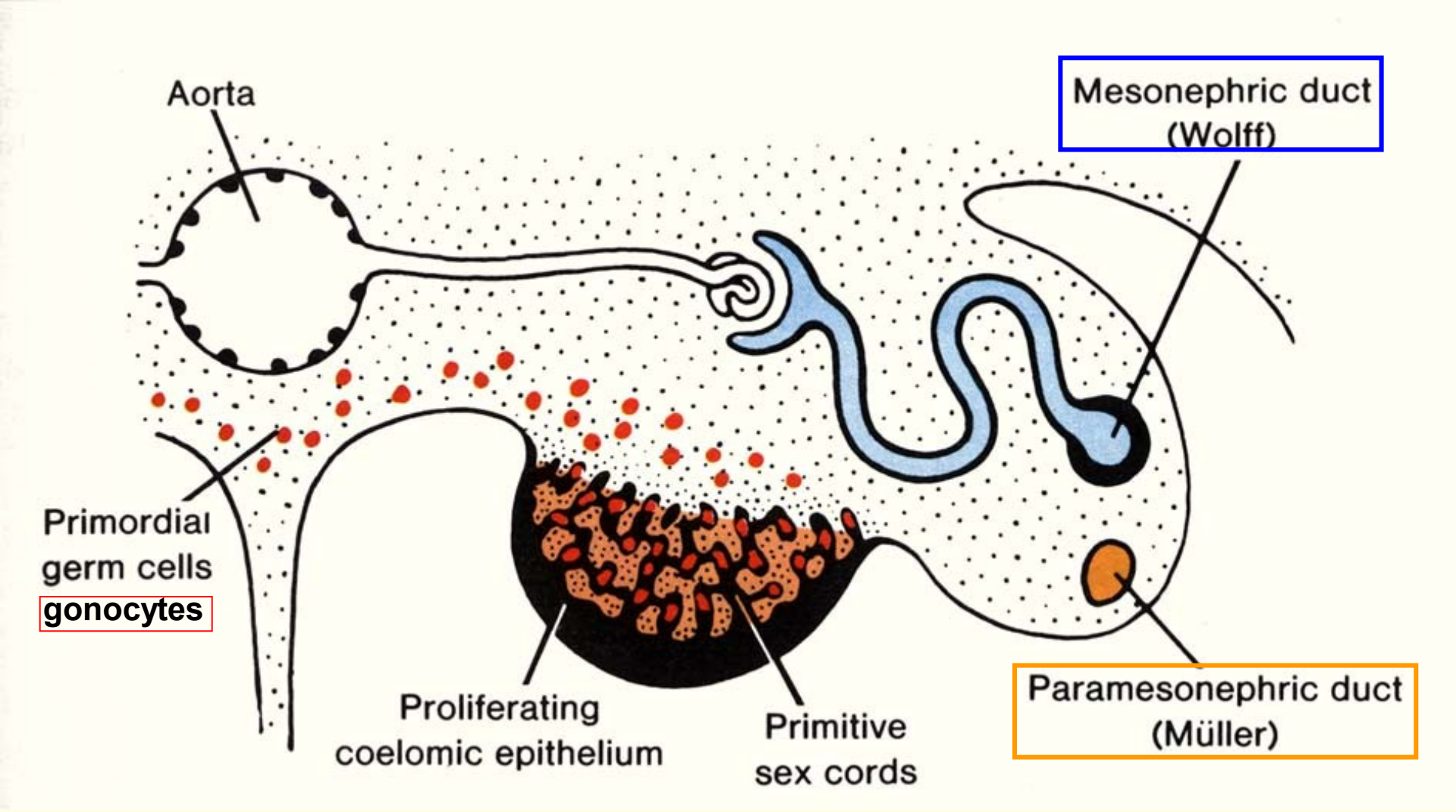


Three sources of gonad development:

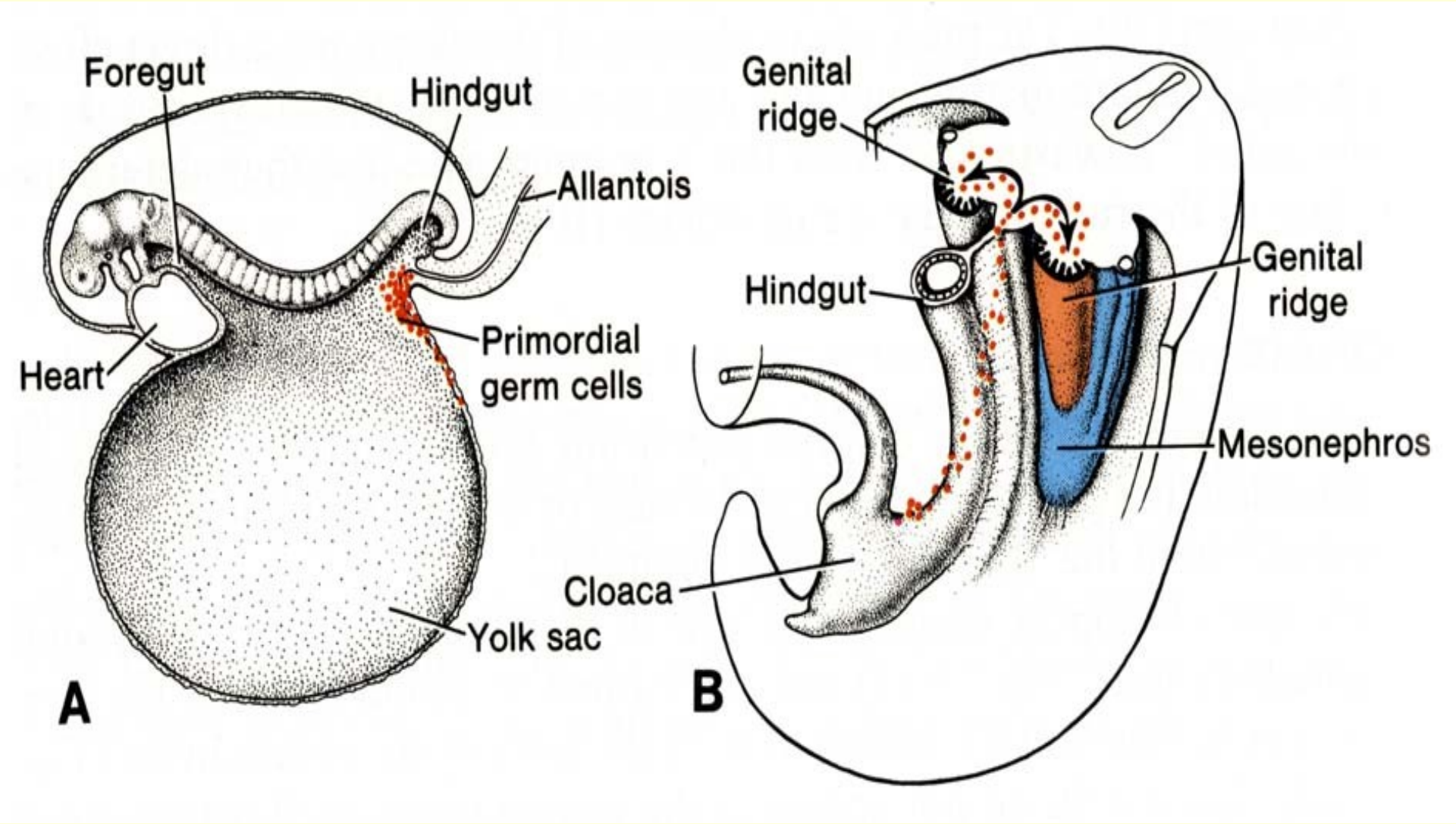
1 – mesenchyme of gonadal ridges (plica genitalis)

2 – coelomic epithelium (mesodermal origin)

3 – gonocytes (primordial cells)

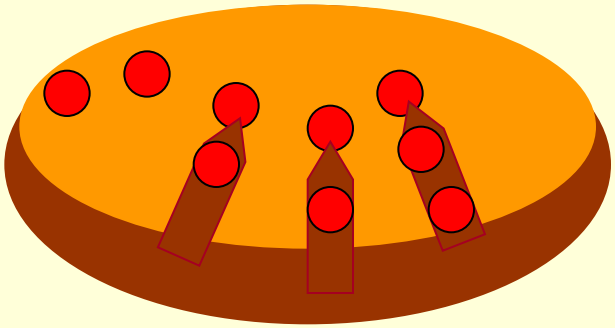


Primordial germ cells – gonocytes – in endoderm of dorsal wall of yolk sac. Gonocytes migrate along dorsal mesentery of hindgut into the gonadal ridges and induce (!) gonad development.



Indifferent gonad development

- Gonocytes induce coelomic epithelium to proliferate (primary proliferation)



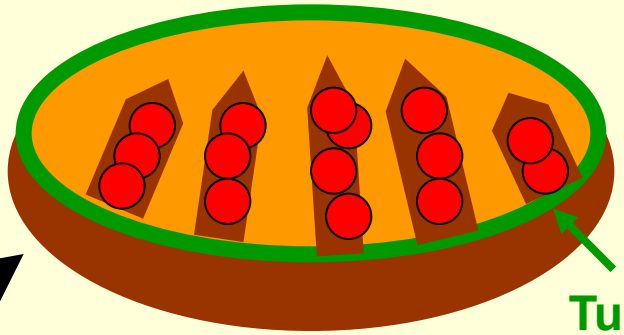
Together with **gonocytes**, **cells of coelomic epithelium** in **mesenchyme** form -

- primary sex cords

in indifferent gonad

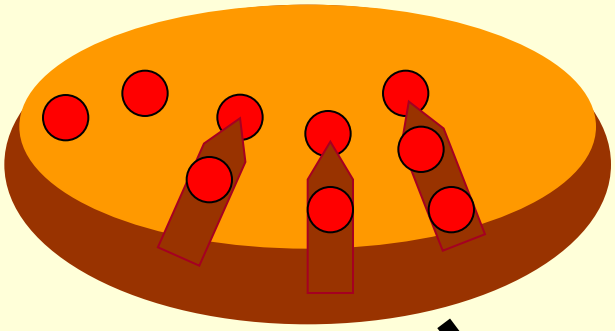
Primary proliferation (male)
Secondary proliferation (female)

TESTIS



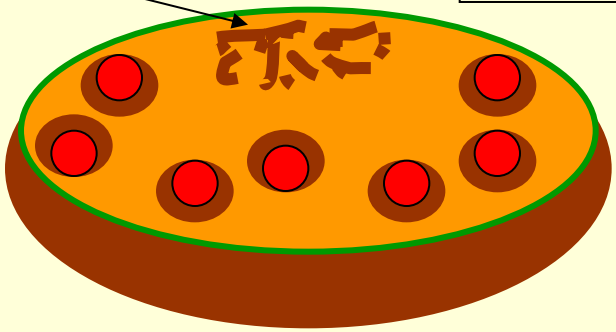
Tunica albuginea

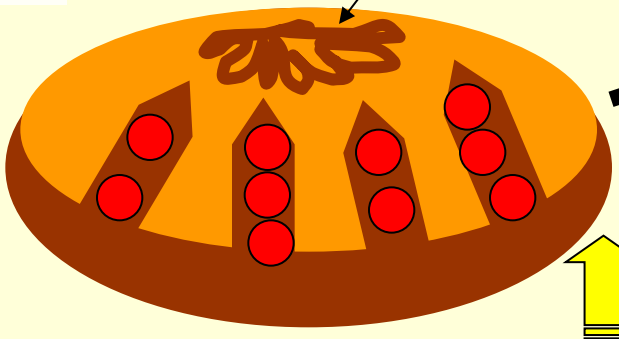
INDIFFERENT GONAD



primary sex cords
= medullary cords

OVARY





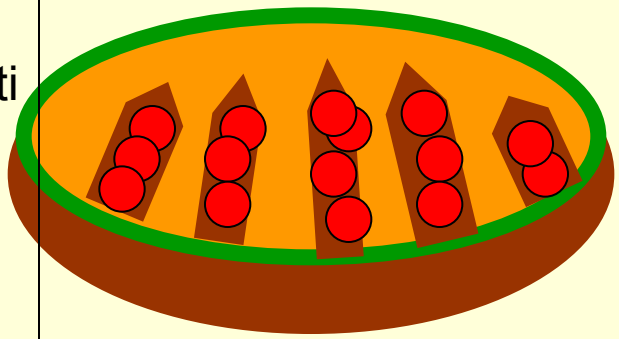
secondary sex cords
= cortical cords

ONLY
in ovary

TESTIS:

Primary sex cords ⇨ tubuli semuniferi contorti

Gonocytes ⇨ **spermatogonia**
Coelomic cells ⇨ **Sertoli cells**
Mesenchyme ⇨ **Leydig cells**, interstitial connective tissue

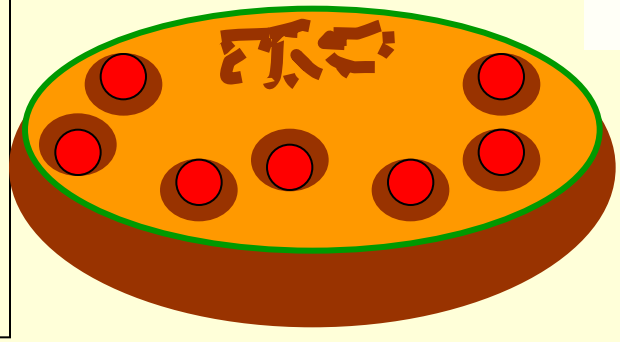


Tunica albuginea

OVARY:

Primary sex cords ⇨ degenerate in ovarian medulla

Secondary sex cords ⇨ disintegrate into the follicles:
Gonocytes ⇨ **oogonia**
Coelomic cells ⇨ **follicular cells**
Mesenchyme ⇨ **ovarian stroma**

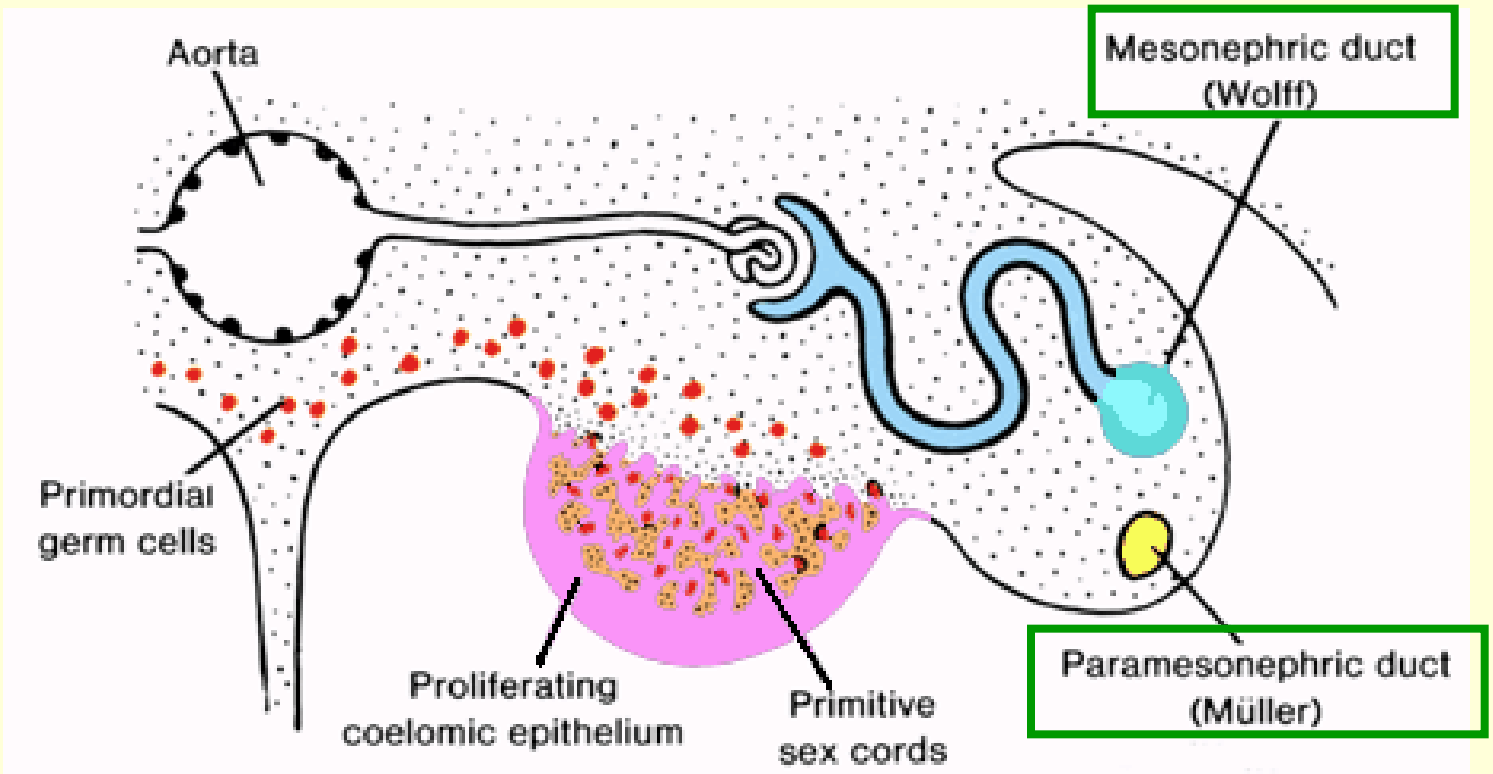


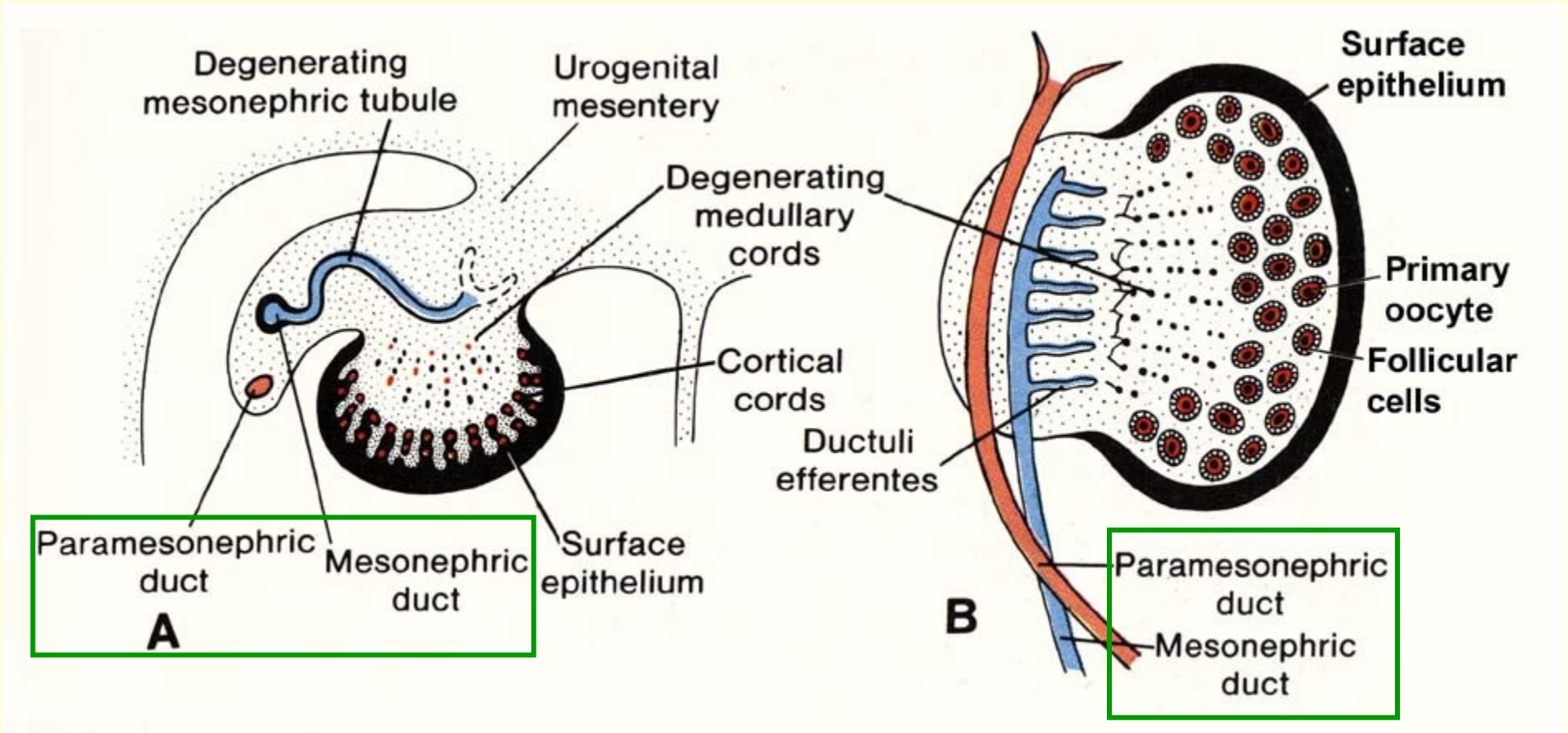
Development of reproductive passages
(indifferent – differentiated stage)

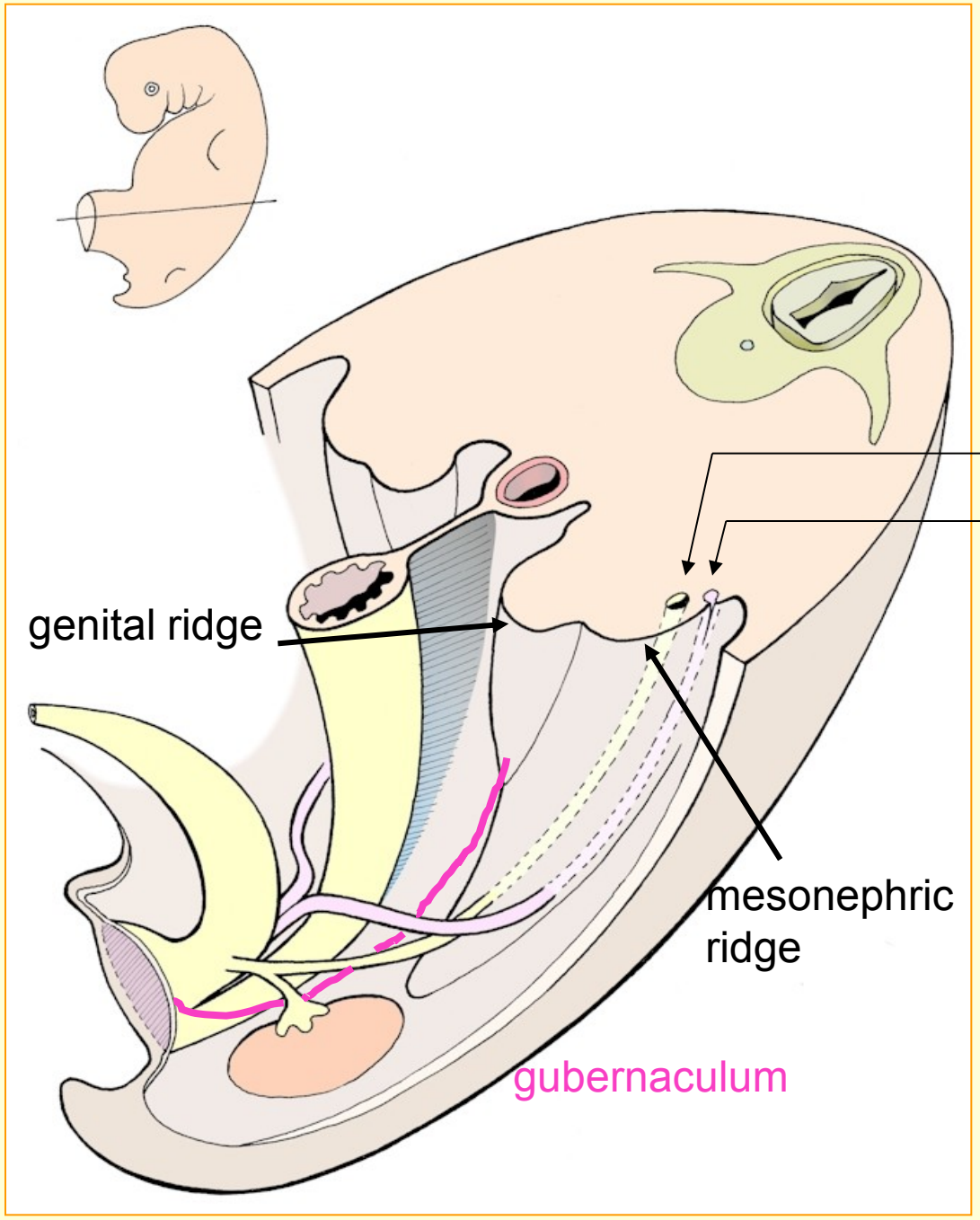
- In mesonephric ridge) – 2 ducts:

Ductus mesonephricus (Wolffi)

Ductus paramesonephricus (Mülleri)

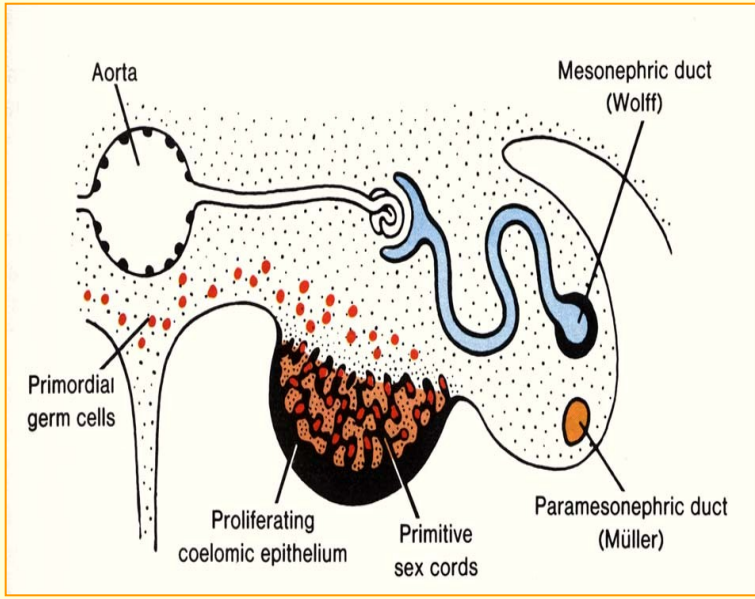



Degenerating mesonephric tubule
Urogenital mesentery
Degenerating medullary cords
Cortical cords
Paramesonephric duct
Mesonephric duct
Surface epithelium
A
Surface epithelium
Primary oocyte
Follicular cells
Ductuli efferentes
Paramesonephric duct
Mesonephric duct
B



Indifferent stage:

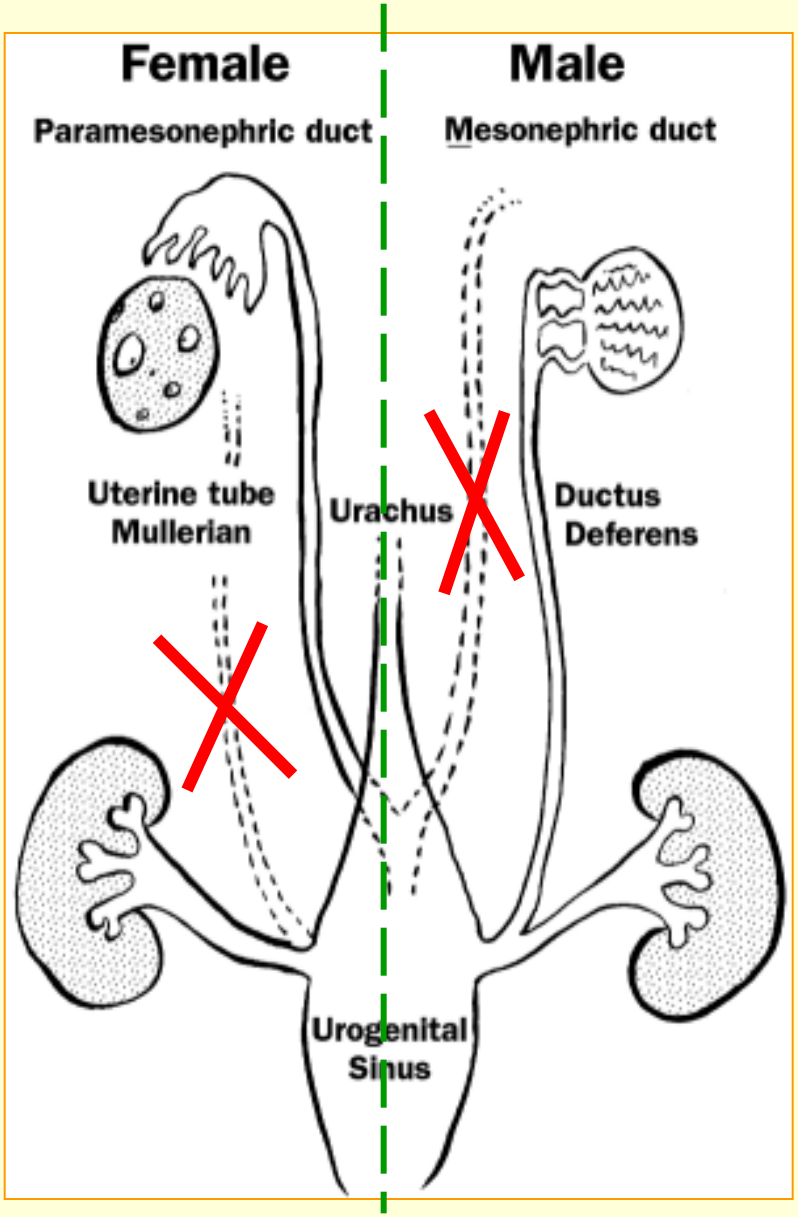
Wolffian duct
Müllerian duct



Differentiated stage of development:

Müllerian duct:

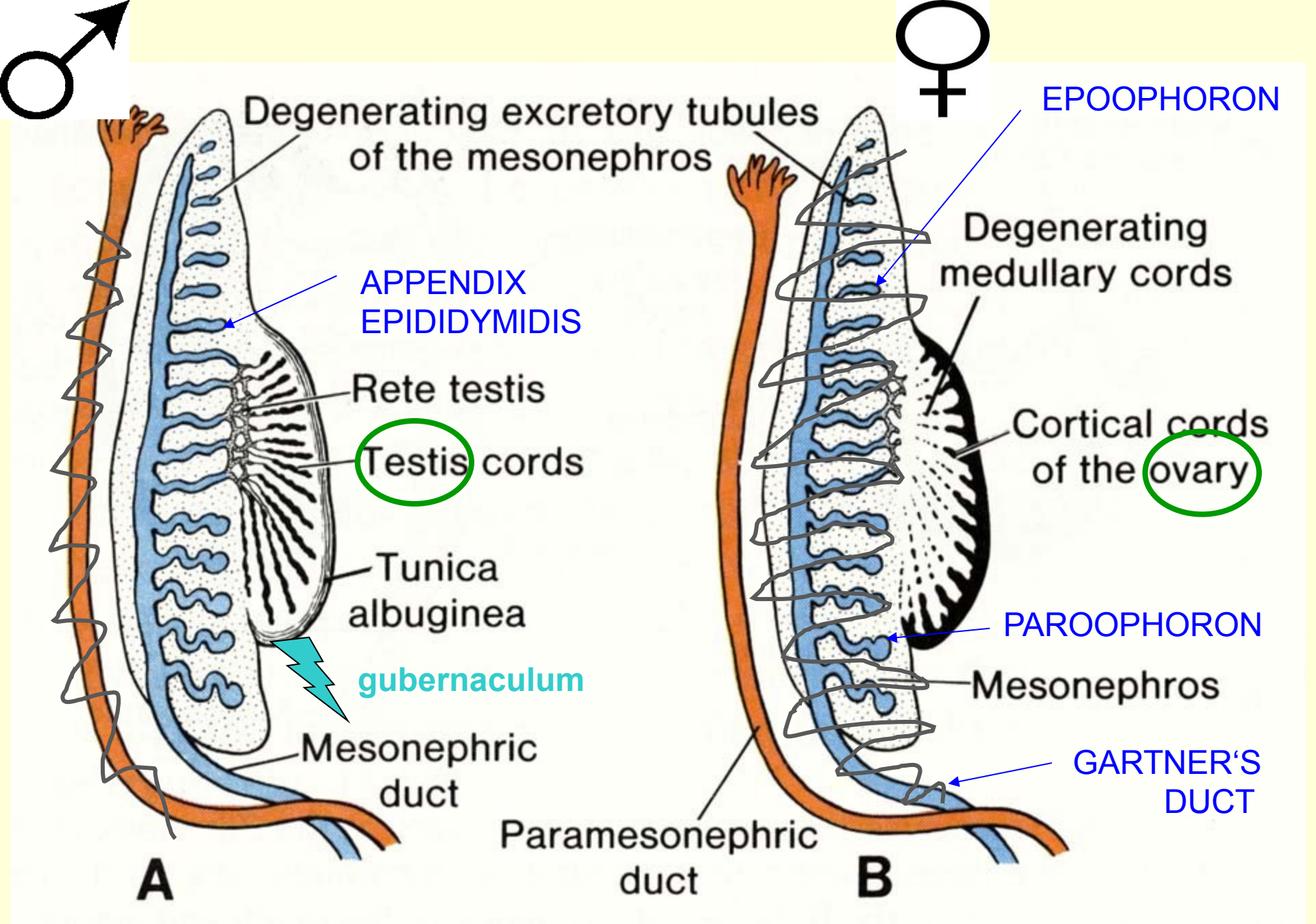
Oviduct
Uterus
Cranial part of vagina



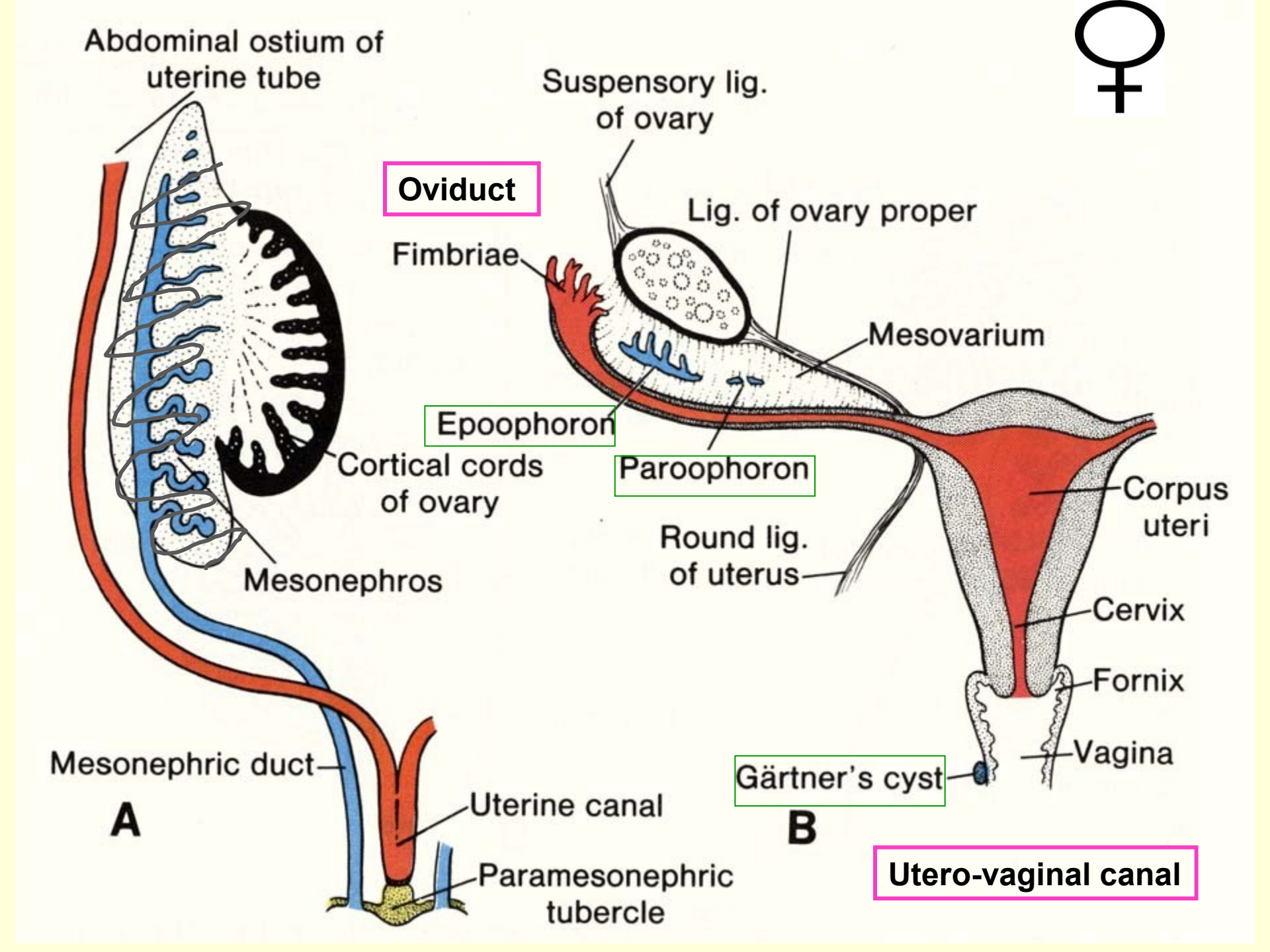
Wolffian duct:

Ductus epididymidis
Ductus deferens
Ductus ejaculatorius

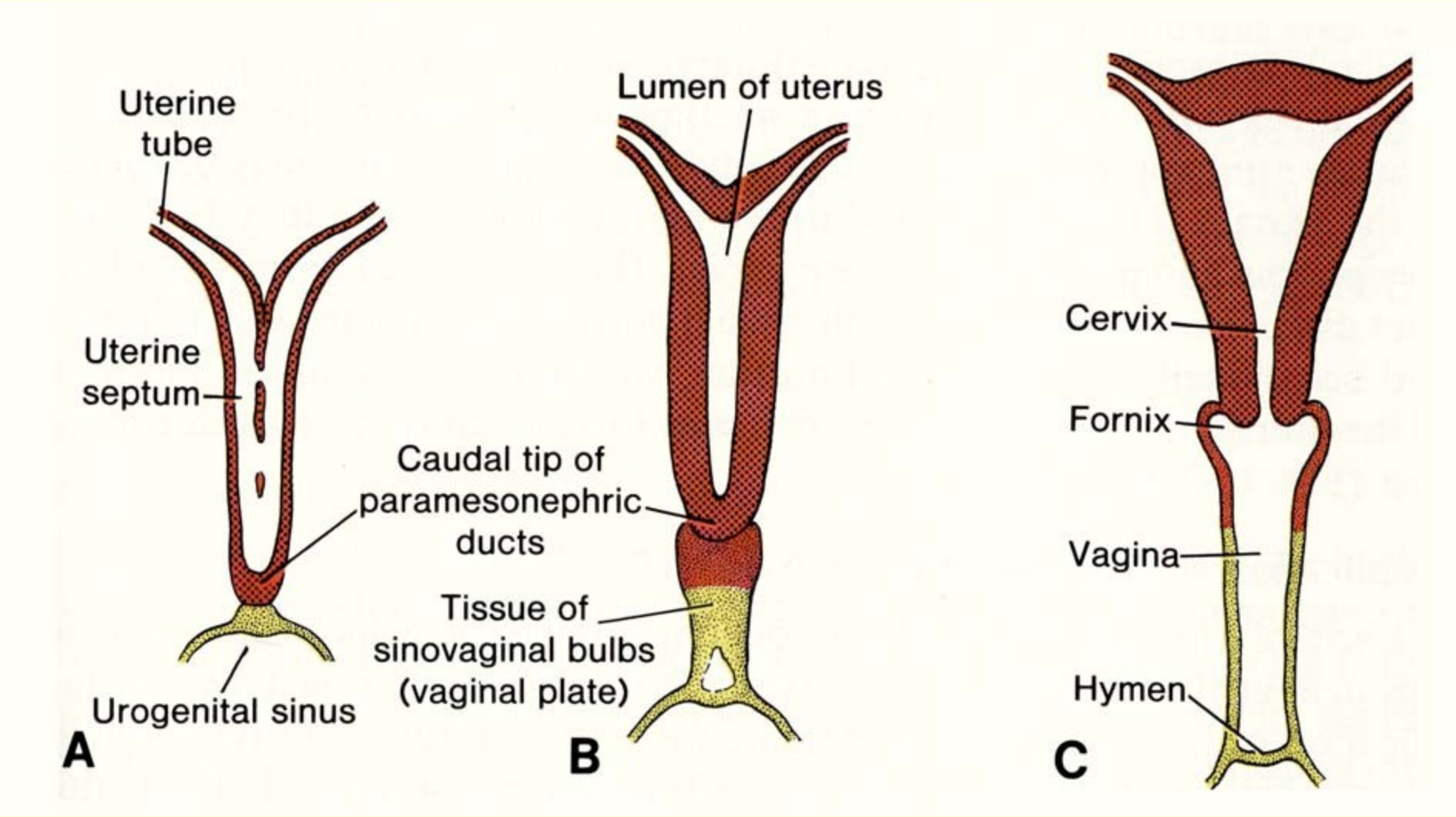
Ductuli efferentes in epididymis and rete testis originate from mesonephric tubules (see mesonephros)

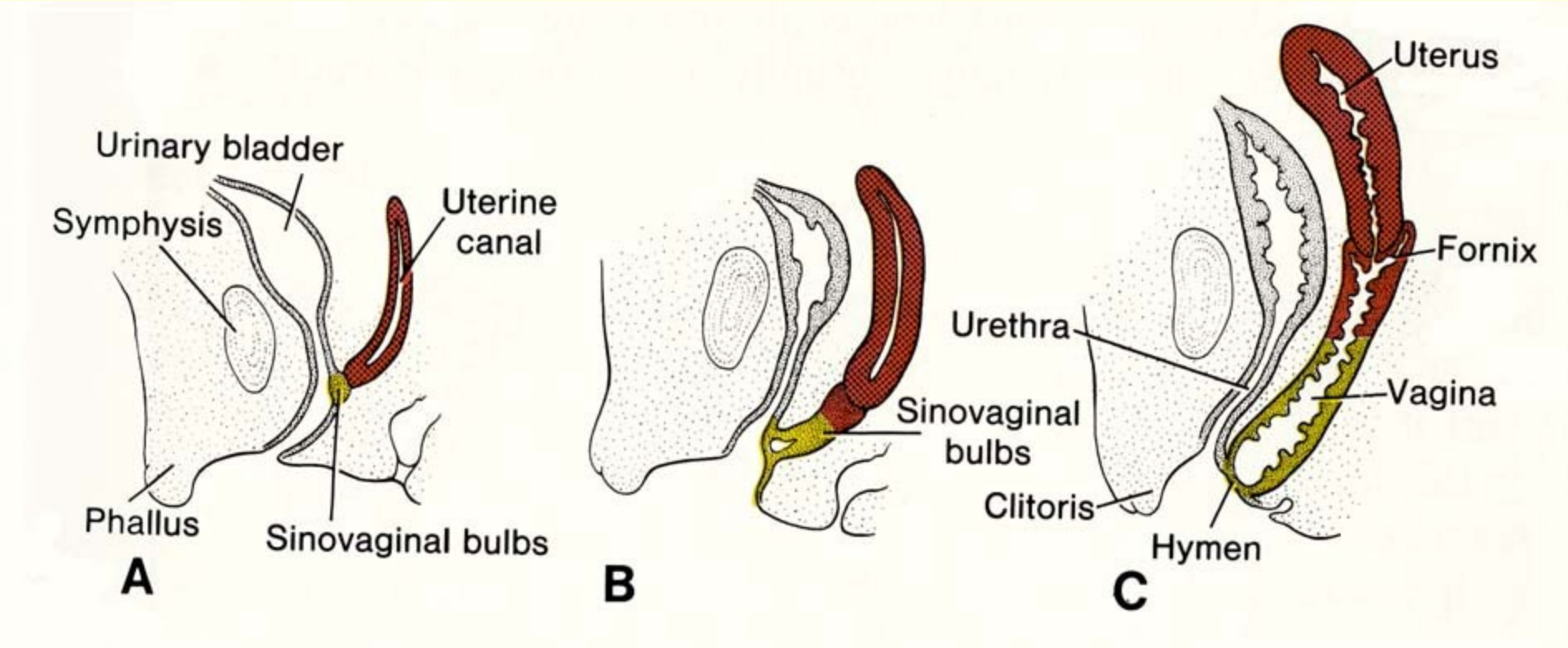


+ RUDIMENTARY STRUCTURES


Abdominal ostium of uterine tube
Suspensory lig. of ovary
Oviduct
Lig. of ovary proper
Fimbriae
Mesovarium
Epoophoron
Paroophoron
Cortical cords of ovary
Mesonephros
Round lig. of uterus
Corpus uteri
Cervix
Fornix
Vagina
Gärtner's cyst
Mesonephric duct
A
Uterine canal
Paramesonephric tubercle
B
Utero-vaginal canal

UTEROVAGINAL CANAL




Urinary bladder
Symphysis
Uterine canal
Phallus
Sinovaginal bulbs
A
Sinovaginal bulbs
B
Uterus
Fornix
Urethra
Vagina
Clitoris
Hymen
C

Development of external genatalia

(indifferent – differentiated stage)

Genital tubercle

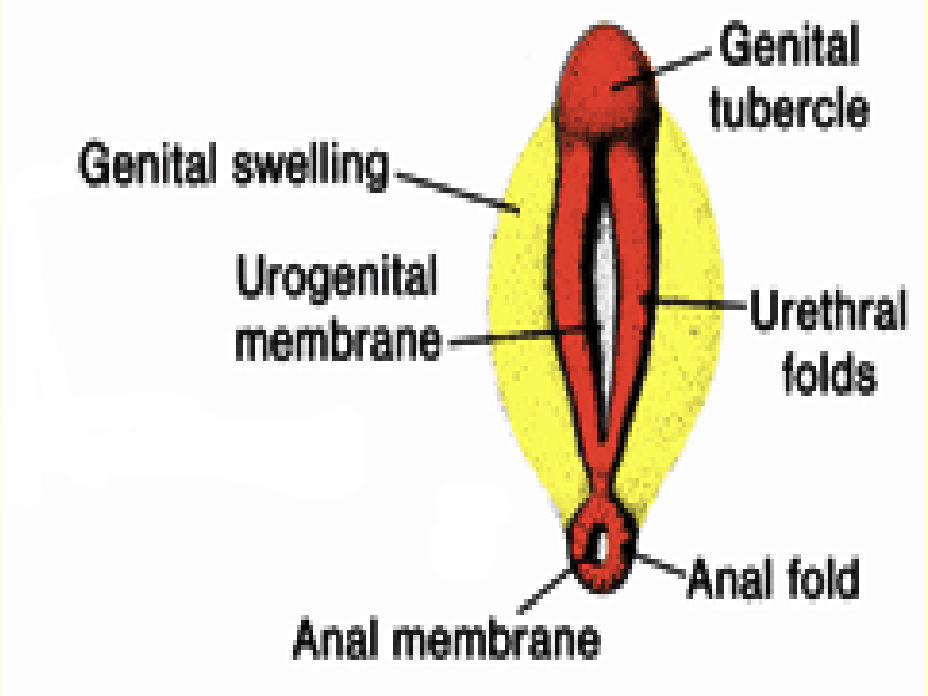
[tuberculum genitale]

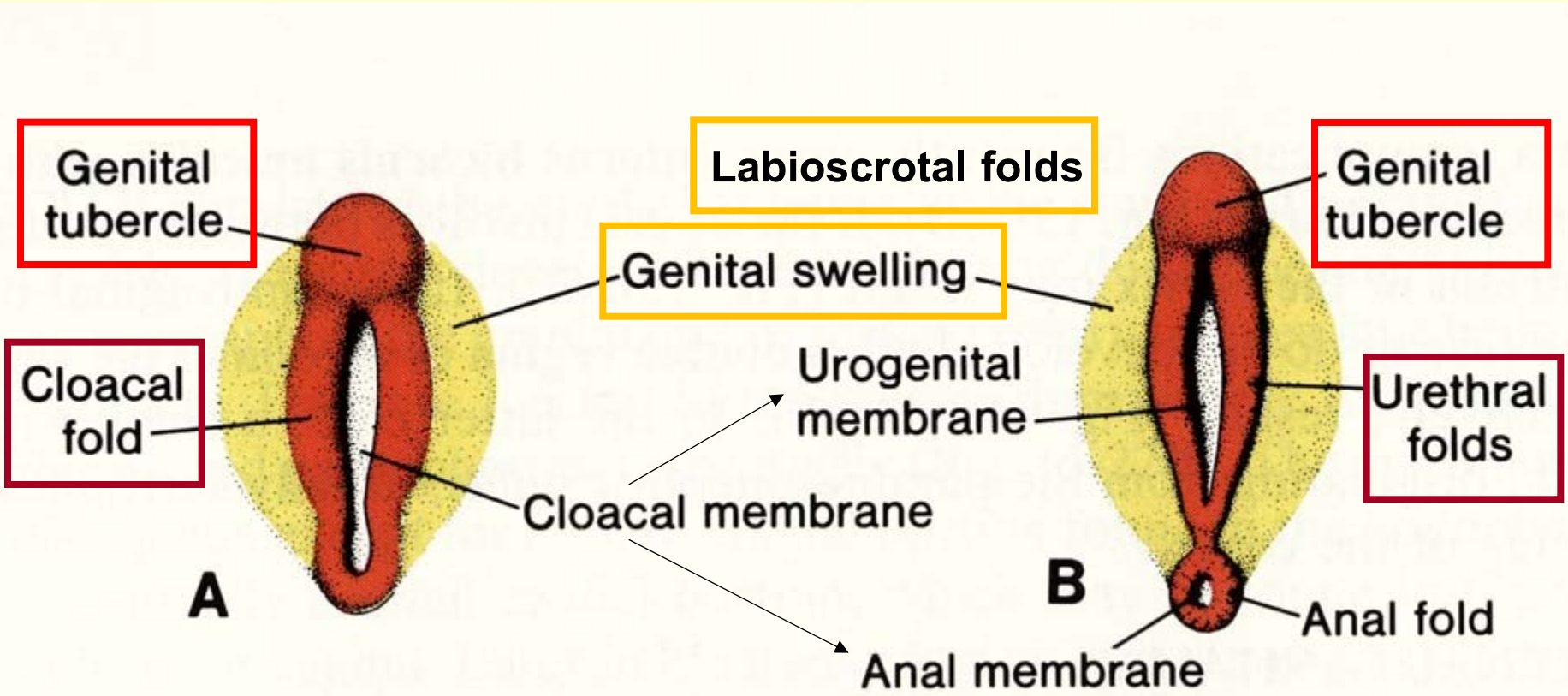
Urethral (cloacal) folds

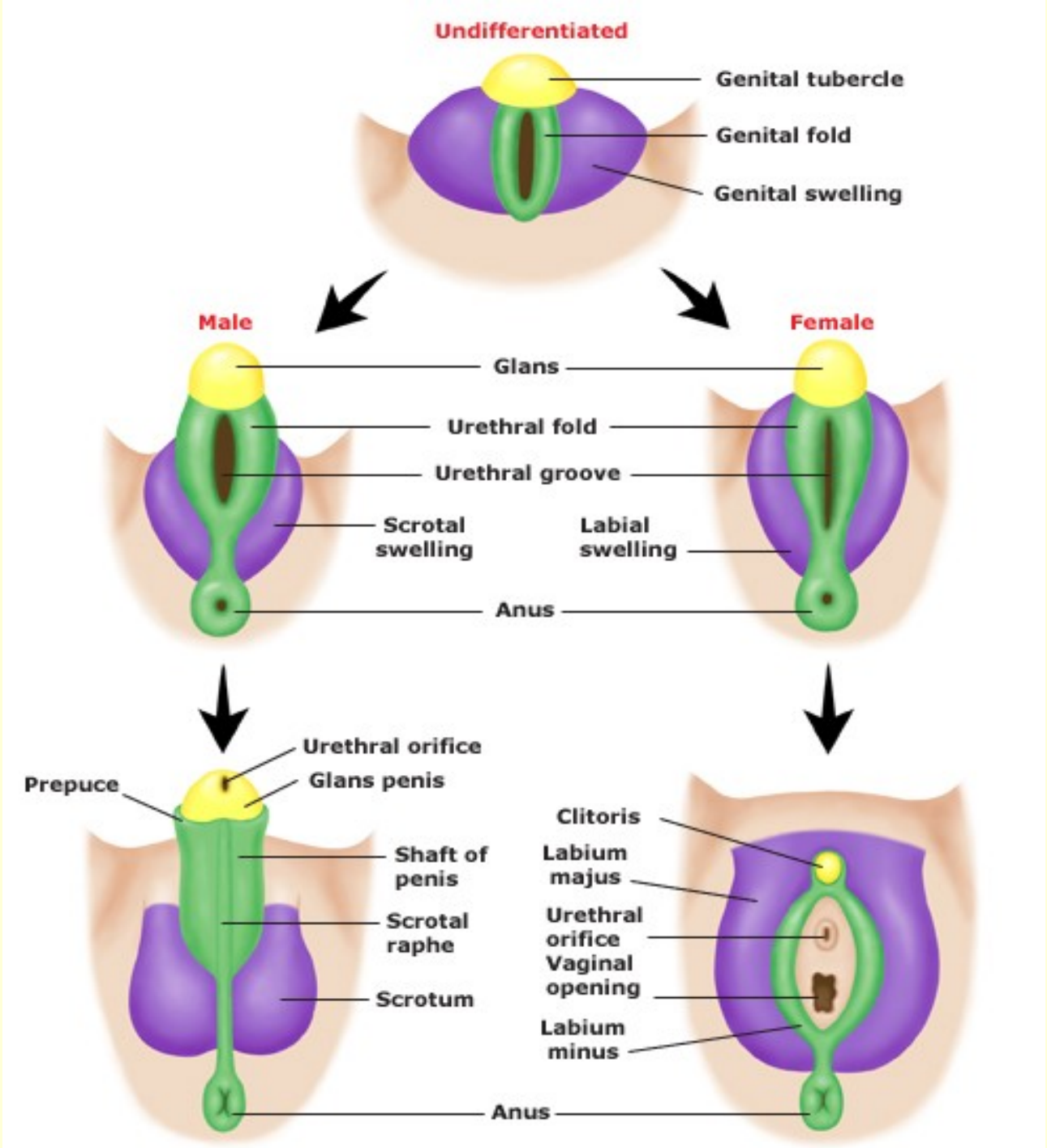
[plicae genitales]

Labio-scrotal swellings

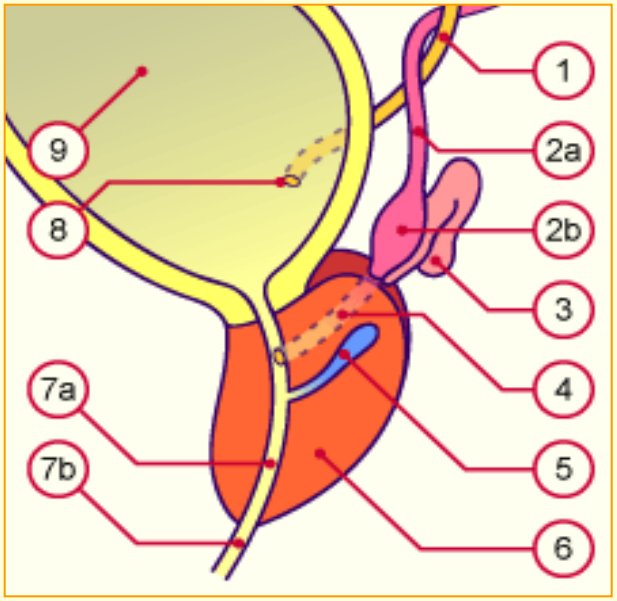
[tori genitales]




Genital tubercle
Labioscrotal folds
Genital tubercle
Genital swelling
Cloacal fold
Urogenital membrane
Urethral folds
Cloacal membrane
A
B
Anal fold
Anal membrane

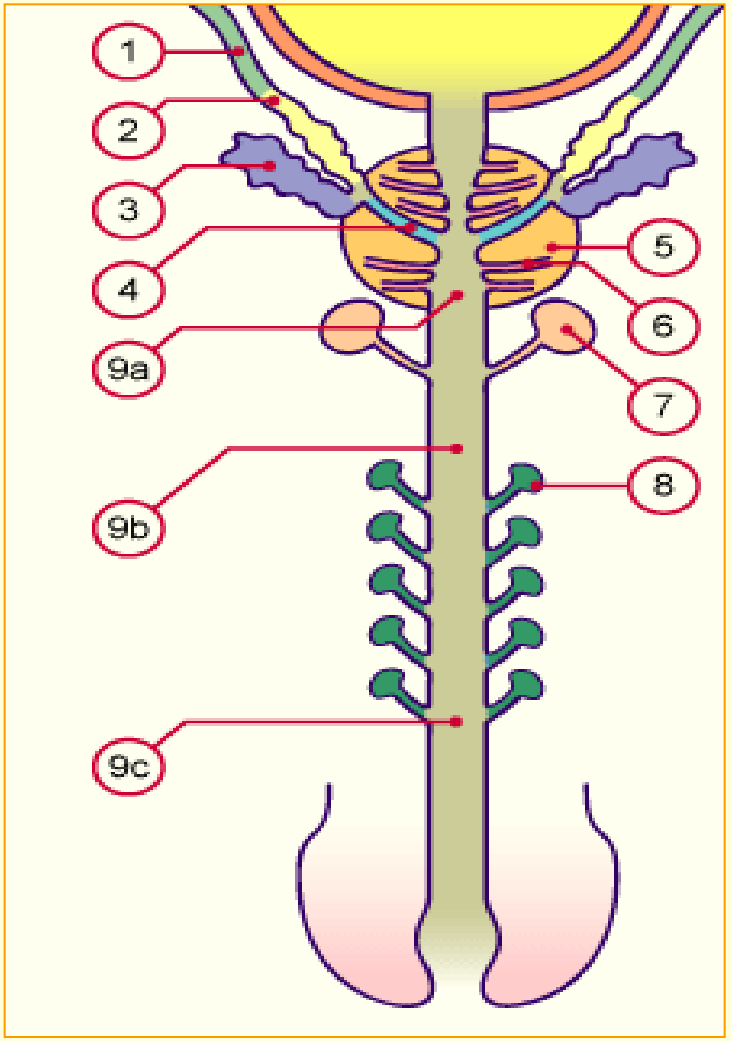

Undifferentiated
Genital tubercle
Genital fold
Genital swelling
Male
Female
Glans
Urethral fold
Urethral groove
Scrotal swelling
Labial swelling
Anus
Urethral orifice
Glans penis
Prepuce
Shaft of penis
Scrotal raphe
Scrotum
Anus
Clitoris
Labium majus
Urethral orifice
Vaginal opening
Labium minus

Accessory glands development



Seminal vesicles – develop as diverticles of ductus deferens (from Wolffian duct)

Prostate – develops around urethra as numerous diverticles (from pelvic part of sinus urogenitalis)

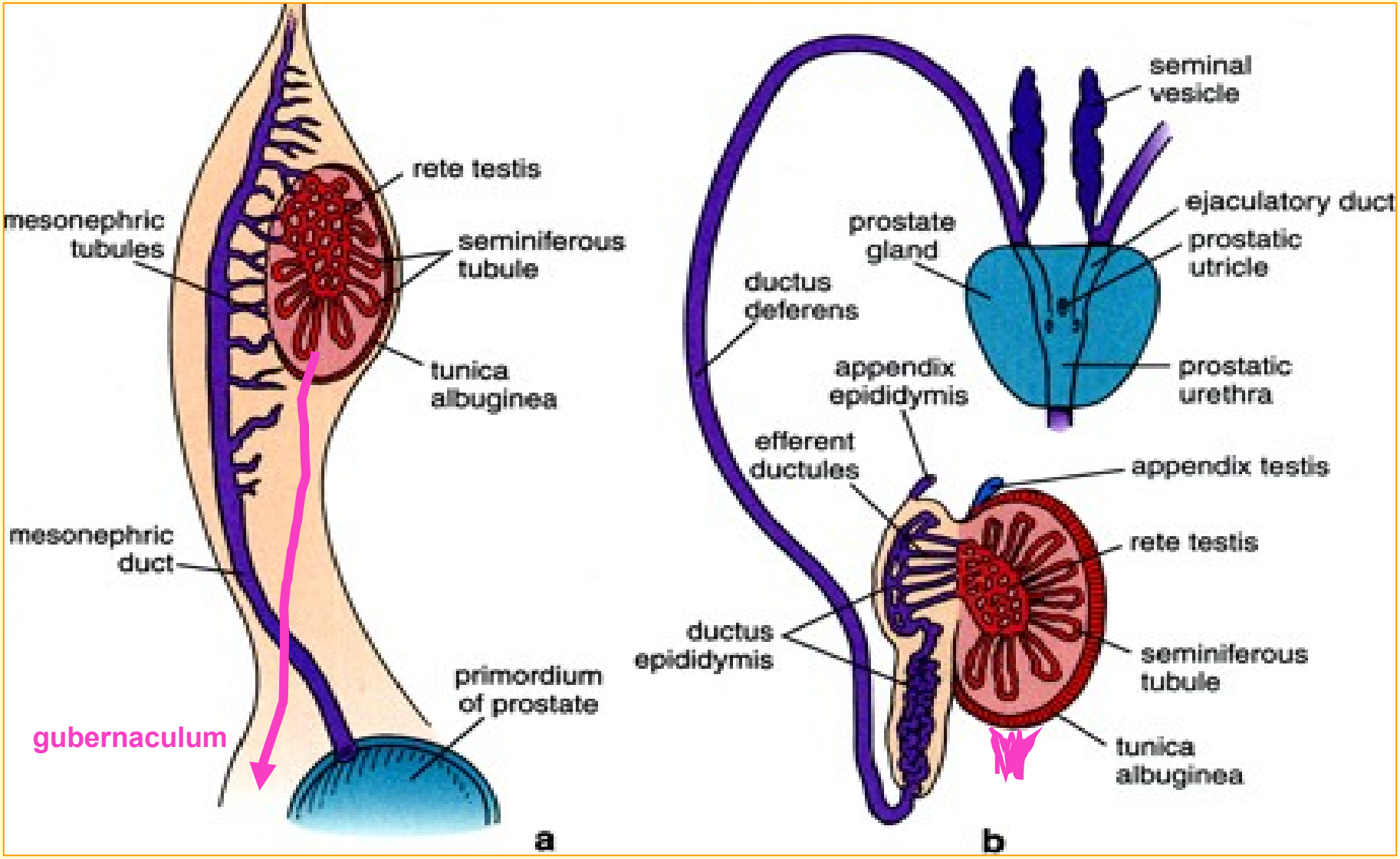


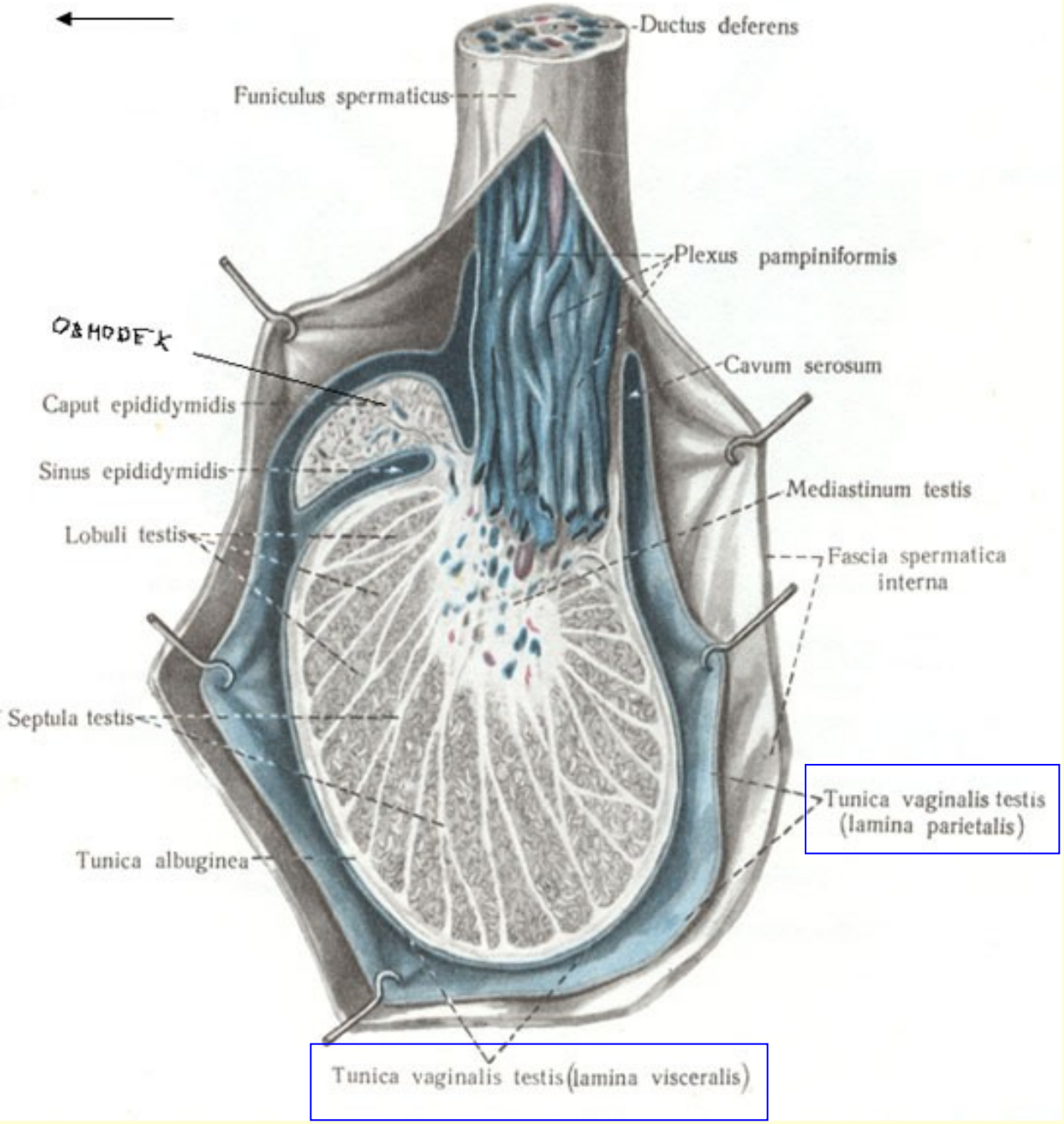
Position of gonads during development

- Gonad develops in only short, lumbal part of genital (gonadal) ridge (Th6 – S2)
- Cranial part - disappeares
- Caudal part transforms into gubernaculum

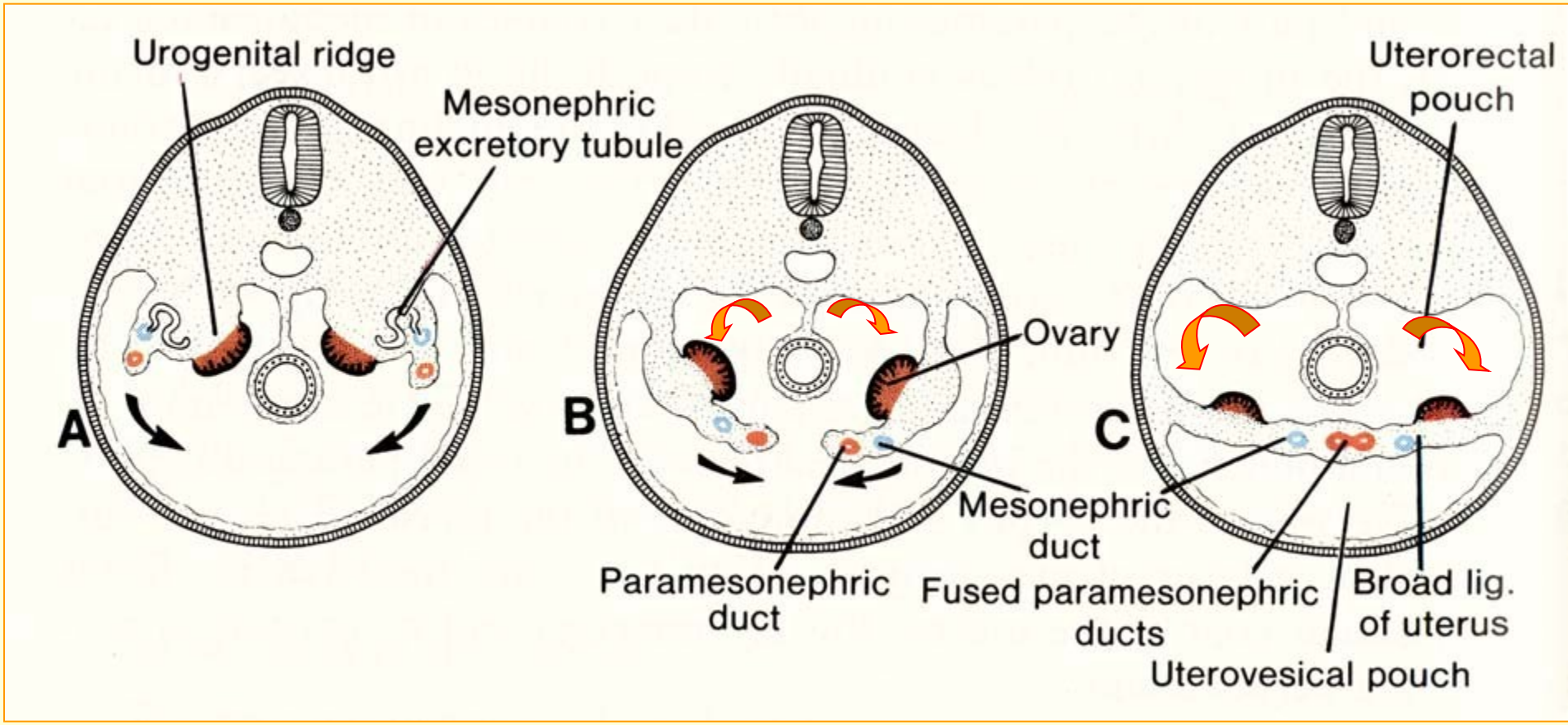
- Testes – descensus into the scrotum
- Ovaries – change also their position due to fusion of Müllerian ducts and formation of broad ligament (lig. latum uteri)

Testis – descens into the scrotum



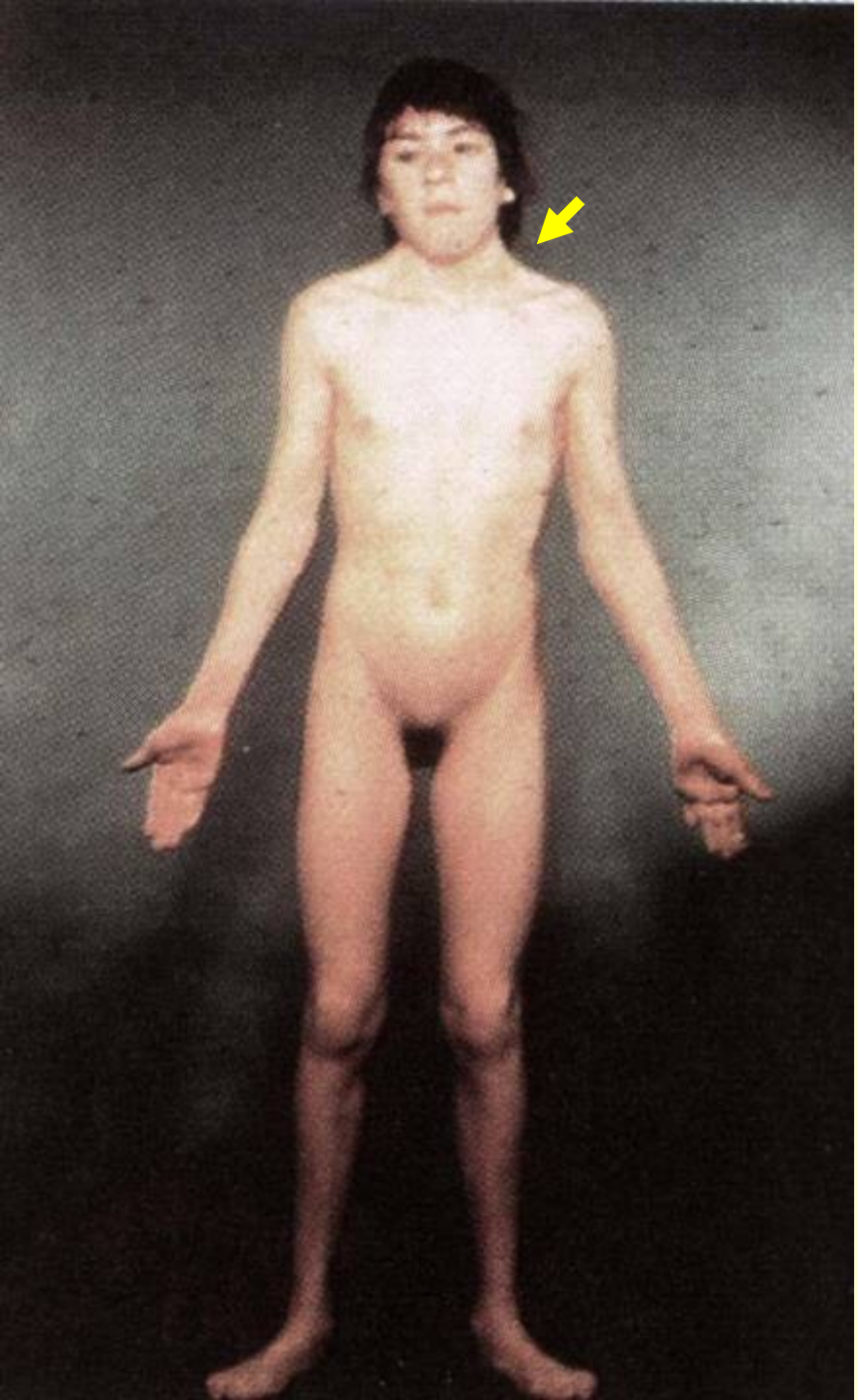

Ductus deferens
Funiculus spermaticus
Plexus pampiniformis
ОБНОВЕК
Cavum serosum
Caput epididymidis
Sinus epididymidis
Mediastinum testis
Lobuli testis
Fascia spermatica interna
Septula testis
Tunica vaginalis testis (lamina parietalis)
Tunica albuginea
Tunica vaginalis testis (lamina visceralis)

Ovaries – change their position due to fusion of Müllerian ducts and formation of broad ligament



Congenital malformations - 1

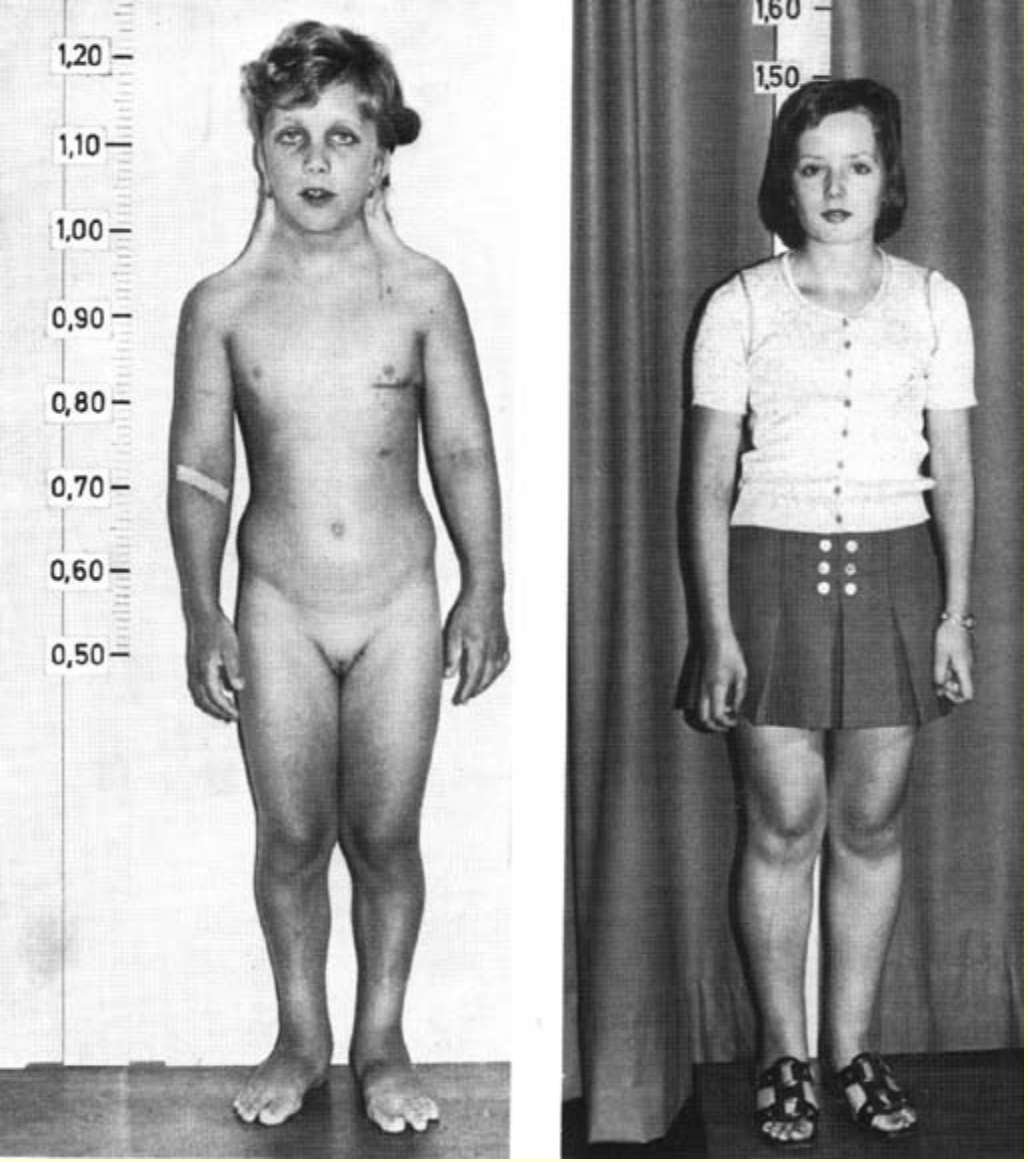
- **Genetic anomalies**:
- Gonad(s) agenesis
- Hermafroditism (ovotestes, ovary+testis) + chromosomal aberations (45X/46XX, 45X/46XY, 47XXY/46X, etc.)
- Pseudohermafroditism – karyotype and gonads do not correspond to external genitalia
- Gonadal hypolasia (dysgenesis) – Turner sy. (45X0), Klinefelter sy. (47XXY)



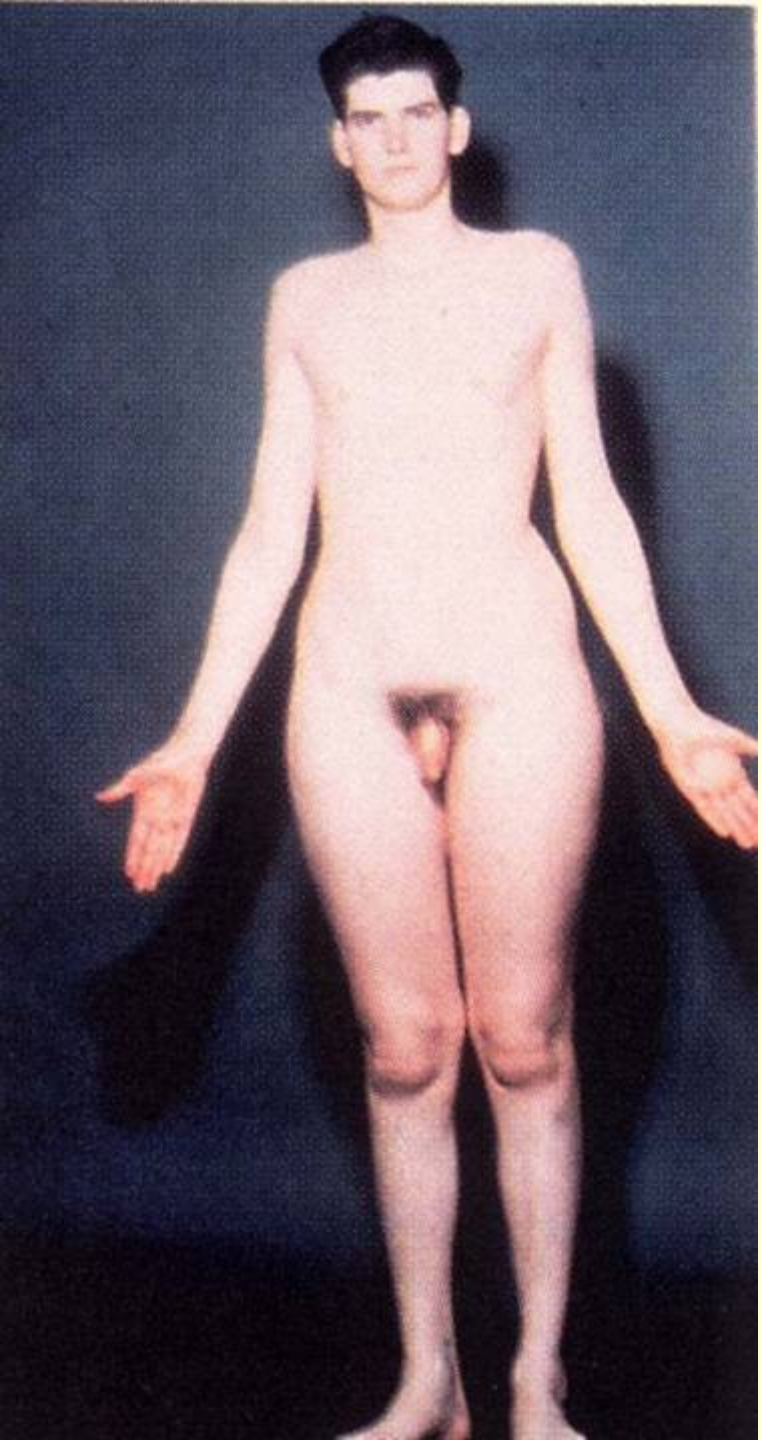
Turner syndrom

(girl - 15 years,150 cm)

pterygium coli



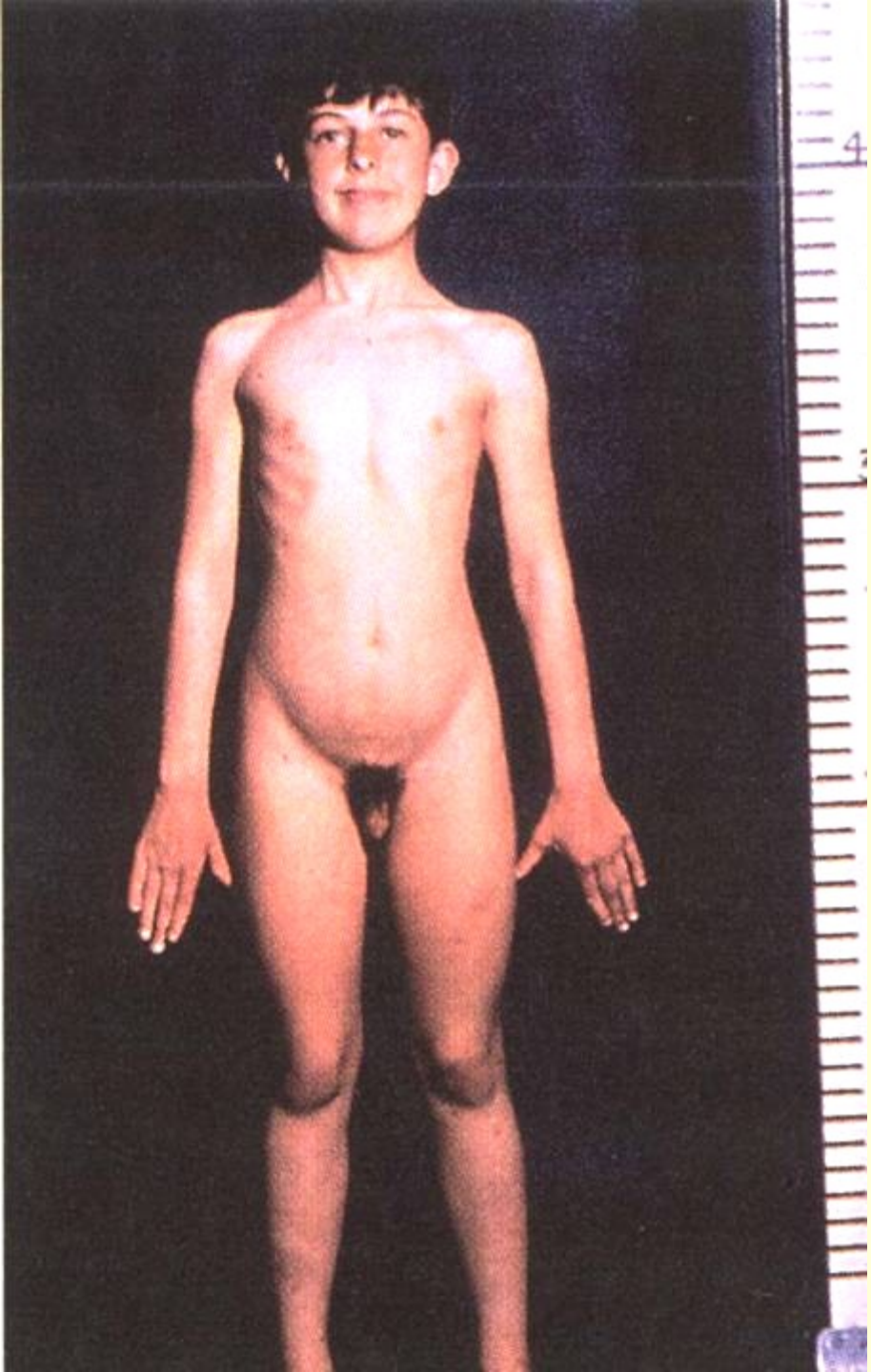
Turner syndrom



Klinefelter syndrom

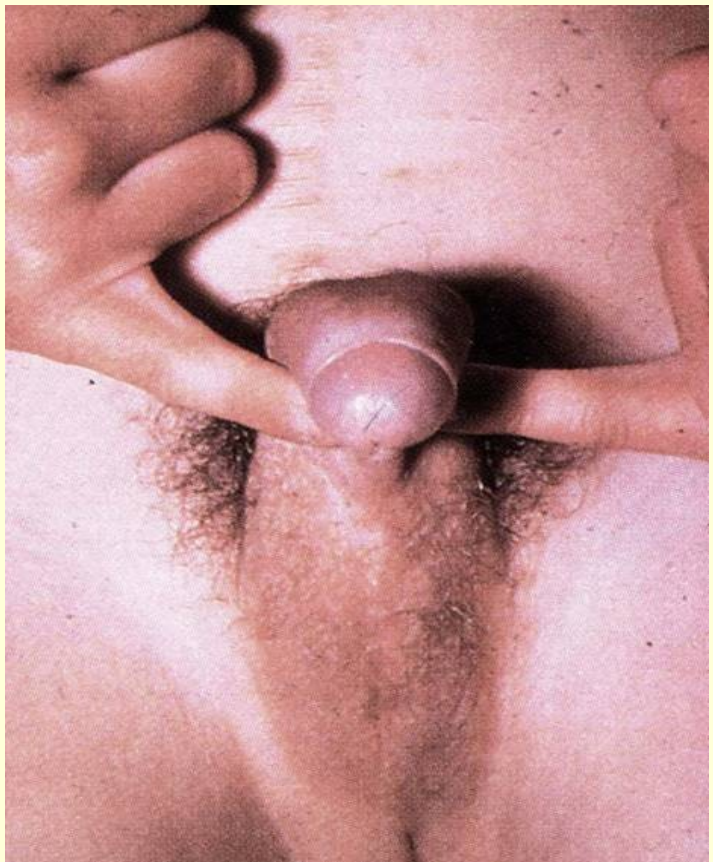
19 years, 180 cm

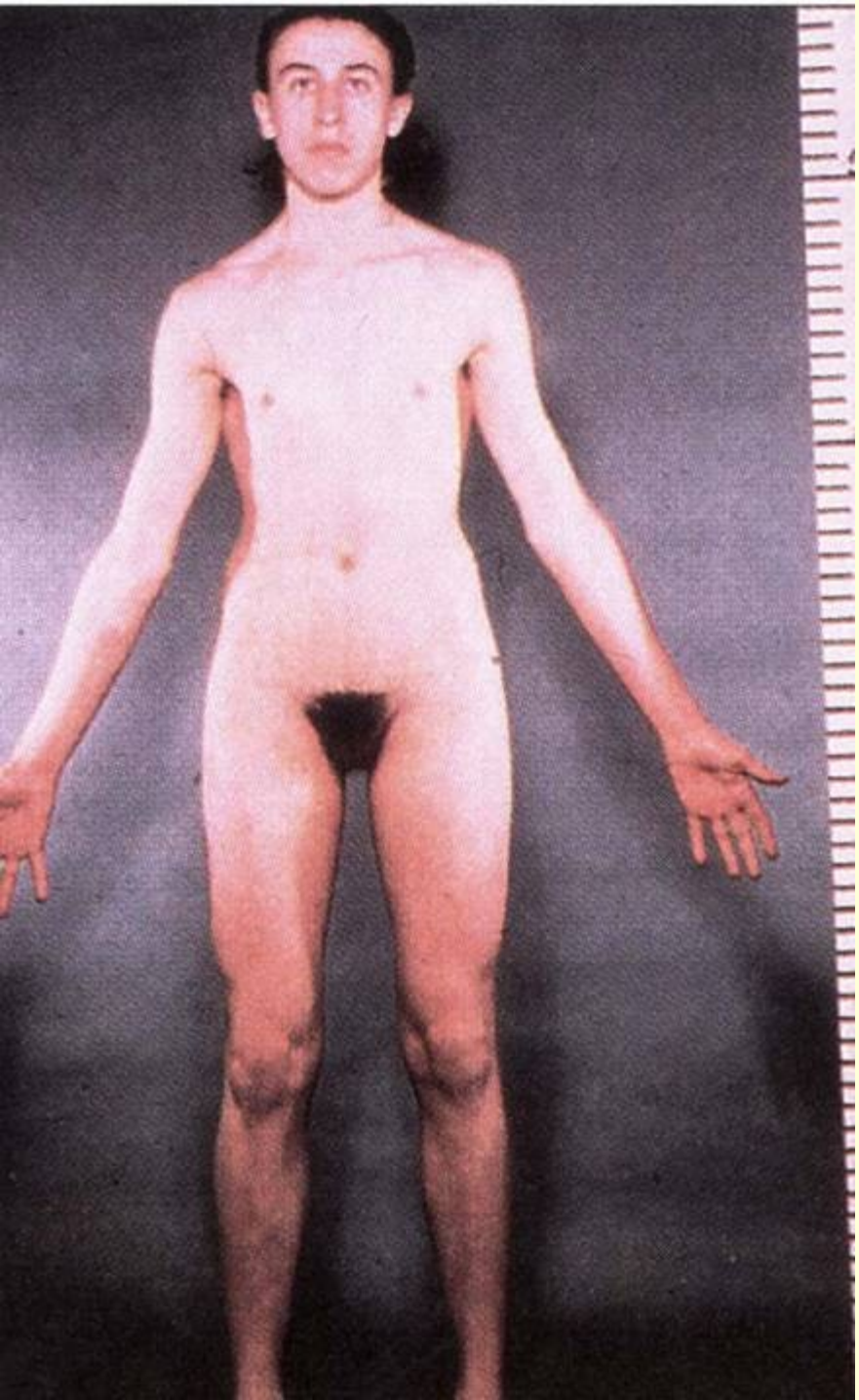
infertility
gynekomastia,



Pseudohermafroditismus femininus

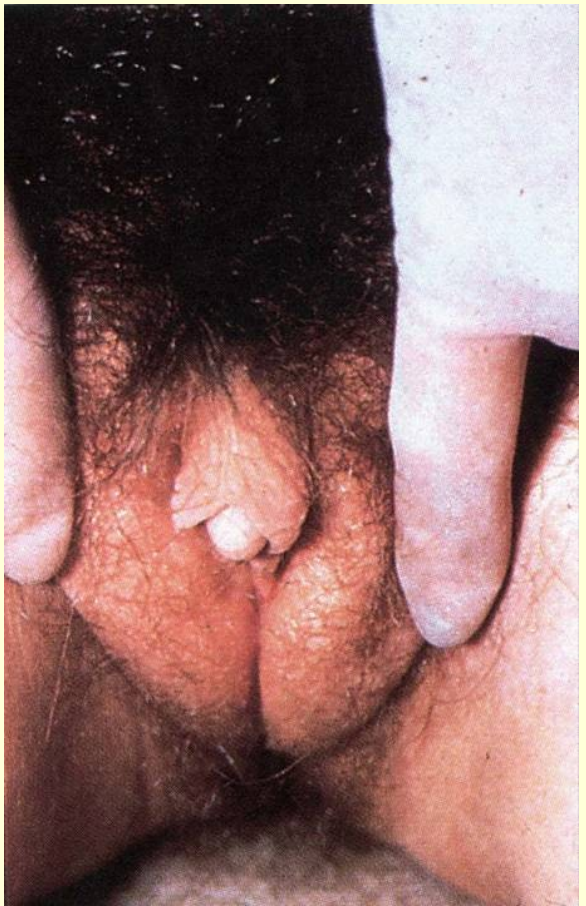
(girl, 12 years)





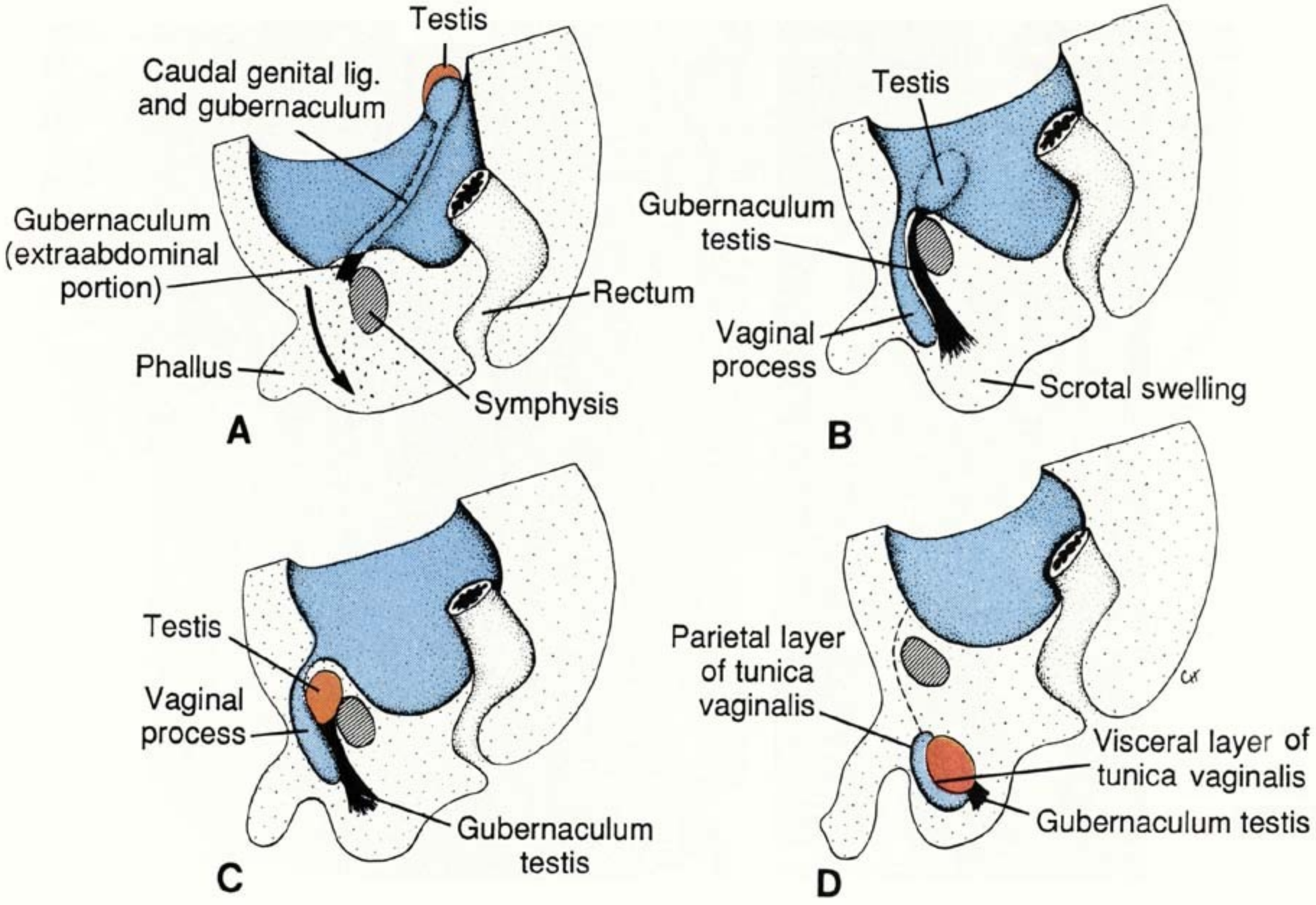
Pseudohermafroditismus masculinus

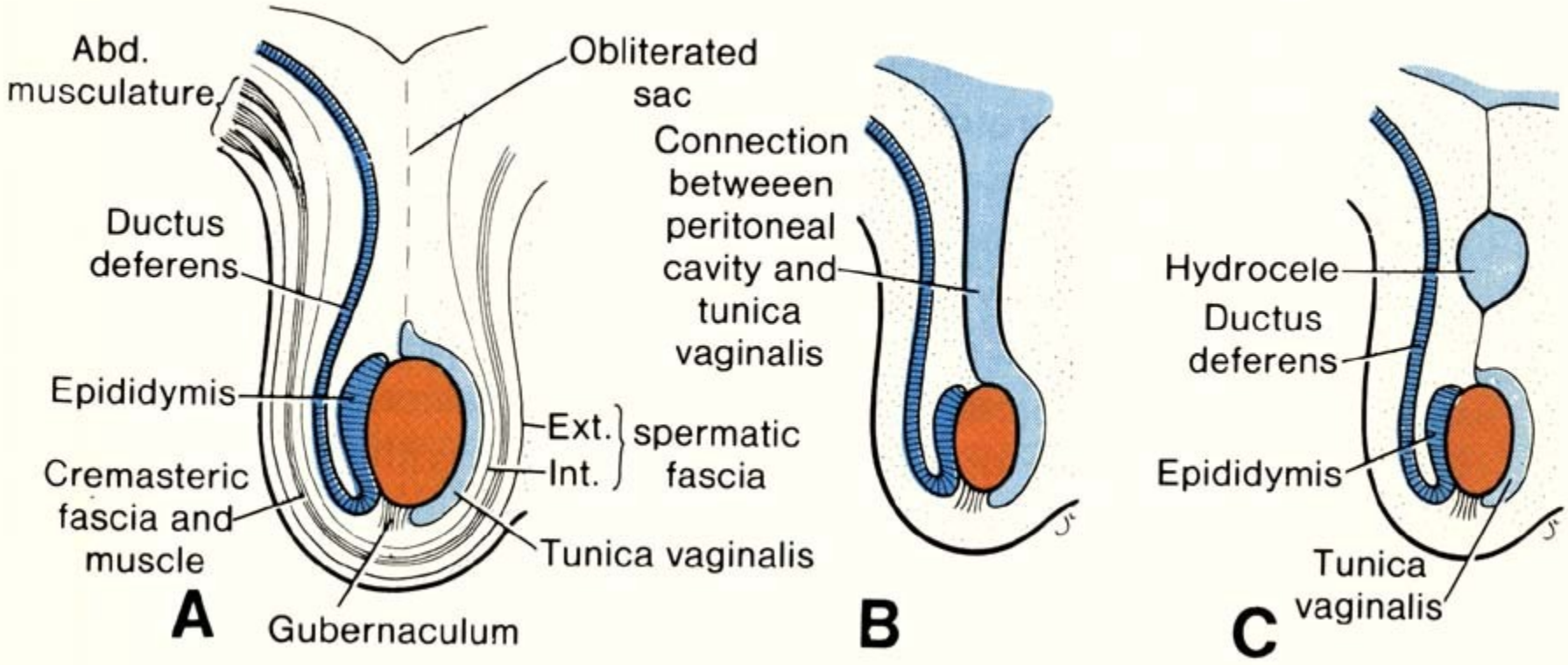
(17 years)



Congenital malformations - 2

- Kryptorchism
- Hydrocele testis
- Hypospadias, epispadias
- _____
- Developmental defect of uterus (and vagina)
  uterus et vagina separatus, uterus bicornis, uterus septus or subseptus, uterus unicornis etc.


Testis
Caudal genital lig. and gubernaculum
Gubernaculum (extraabdominal portion)
Rectum
Phallus
Symphysis
A
Testis
Gubernaculum testis
Vaginal process
Scrotal swelling
B
Testis
Vaginal process
Gubernaculum testis
C
Parietal layer of tunica vaginalis
Visceral layer of tunica vaginalis
Gubernaculum testis
D


Abd.
musculature
Obliterated
sac
Ductus
deferens
Epididymis
Ext.
Int.
spermatic
fascia
Cremasteric
fascia and
muscle
Tunica vaginalis
A
Gubernaculum
Connection
betweeen
peritoneal
cavity and
tunica
vaginalis
B
Hydrocele
Ductus
deferens
Epididymis
Tunica
vaginalis
C

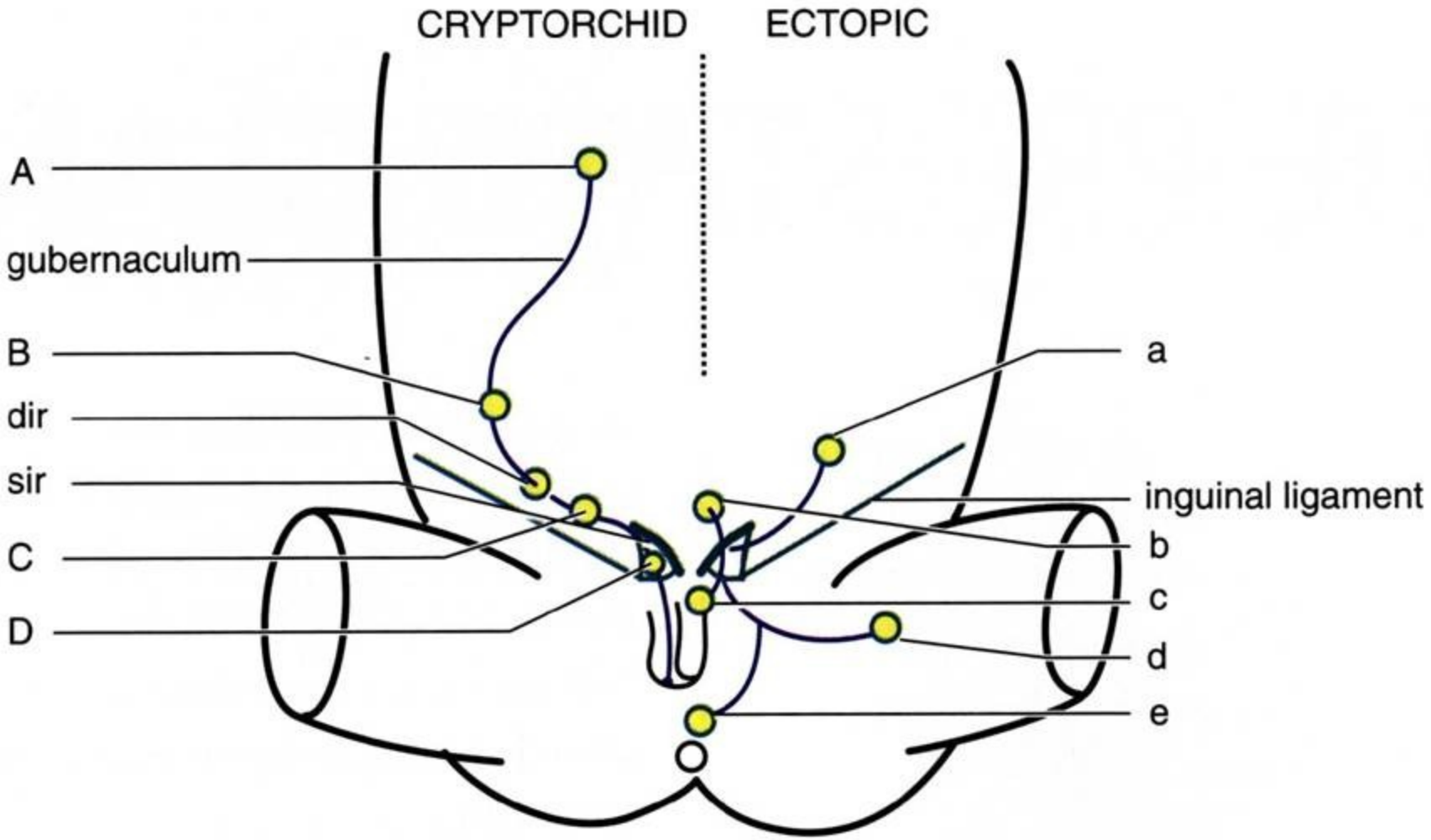
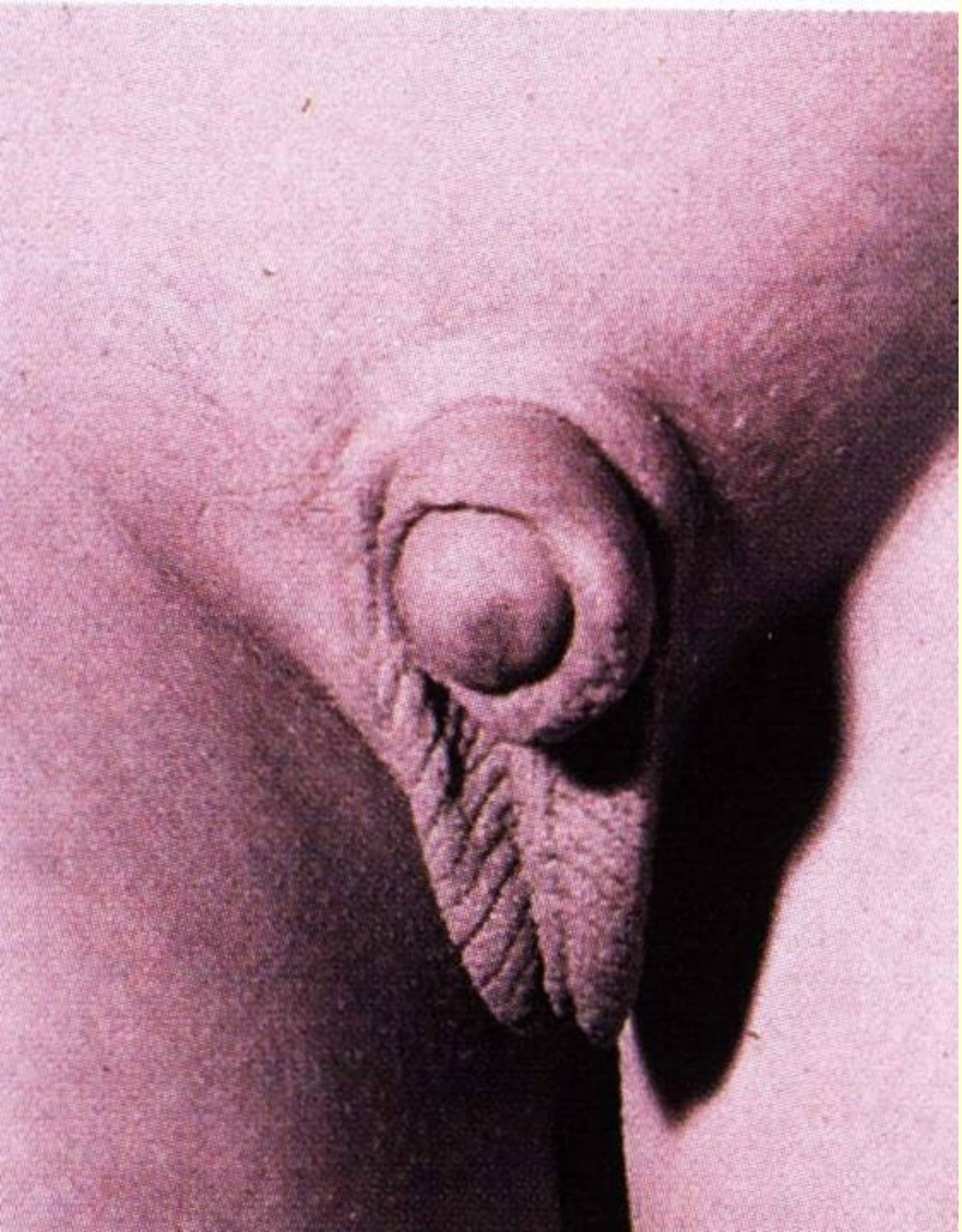


FIGURE 3 Abnormal descent of the testis. On the left, cryptorchid sites of arrest are shown: **A**, abdominal; **B**, pelvic; **C**, inguinal; **D**, at the superficial inguinal ring. **dir**, **sir**, deep and superficial inguinal rings. On the right, ectopic sites are shown: **a**, supra-inguinal; **b**, hypogastric; **c**, pubo-penile; **d**, femoral; **e**, perineal.

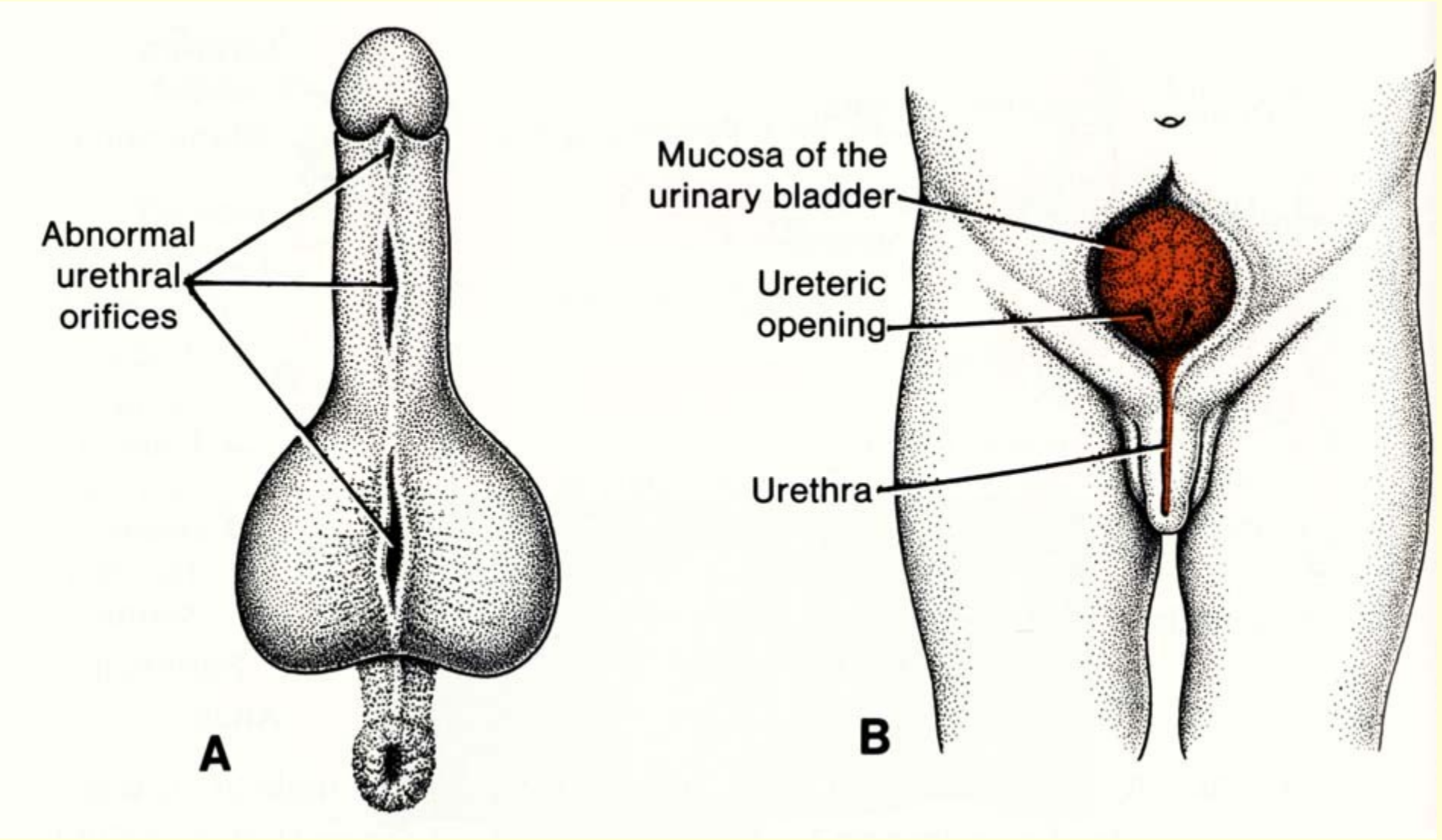


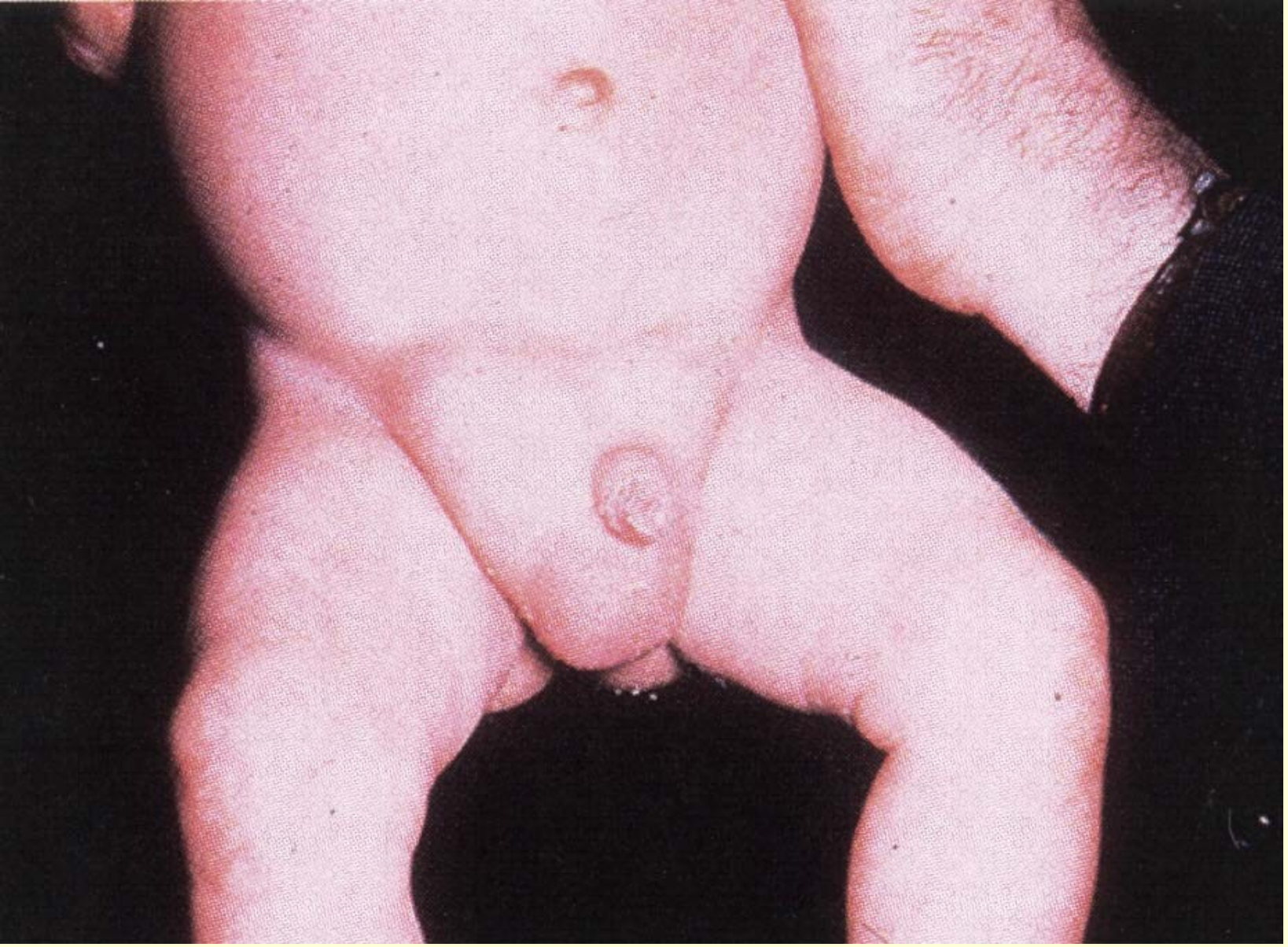
Kryptorchismus

HYPOSPADIE

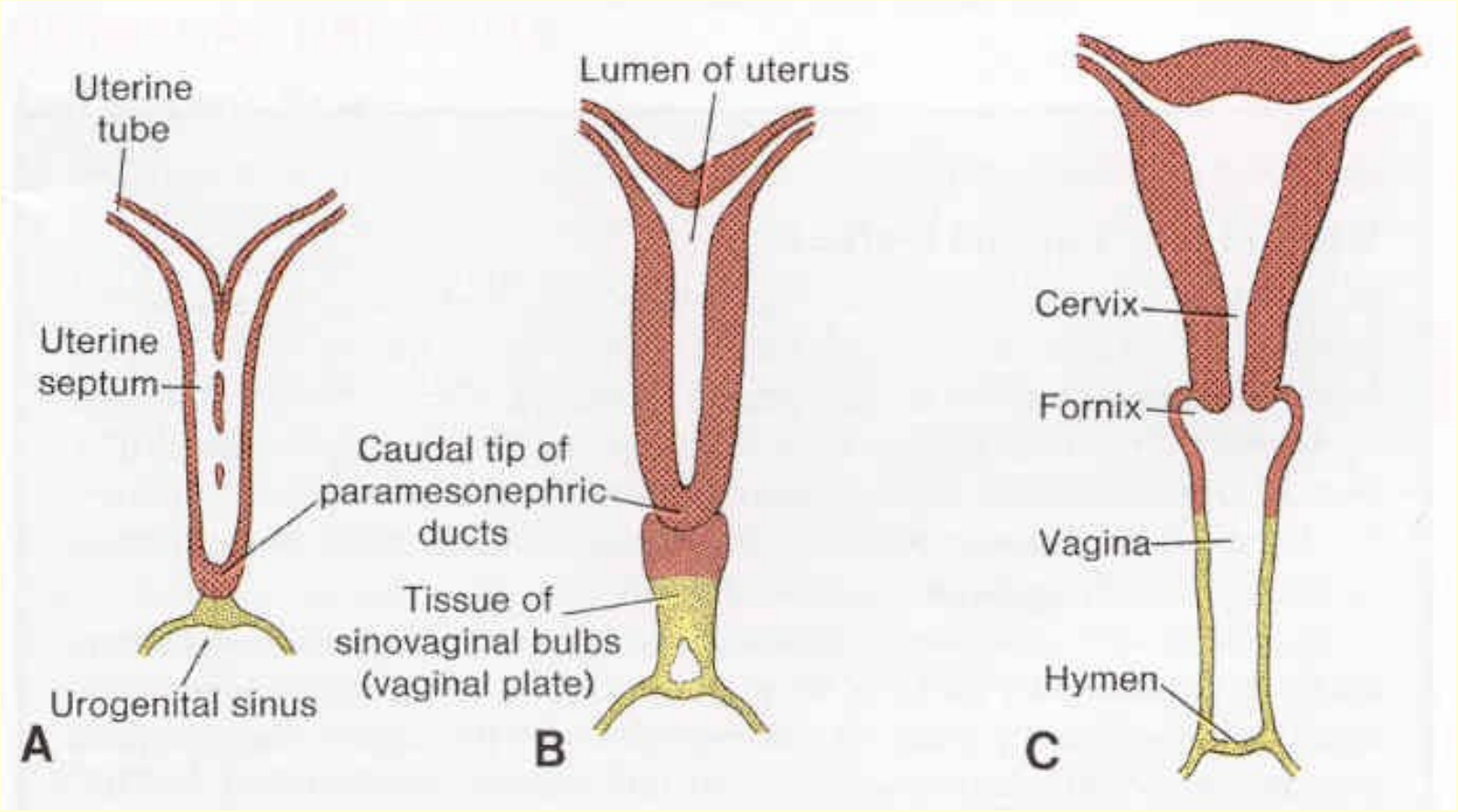
EPISPADIE

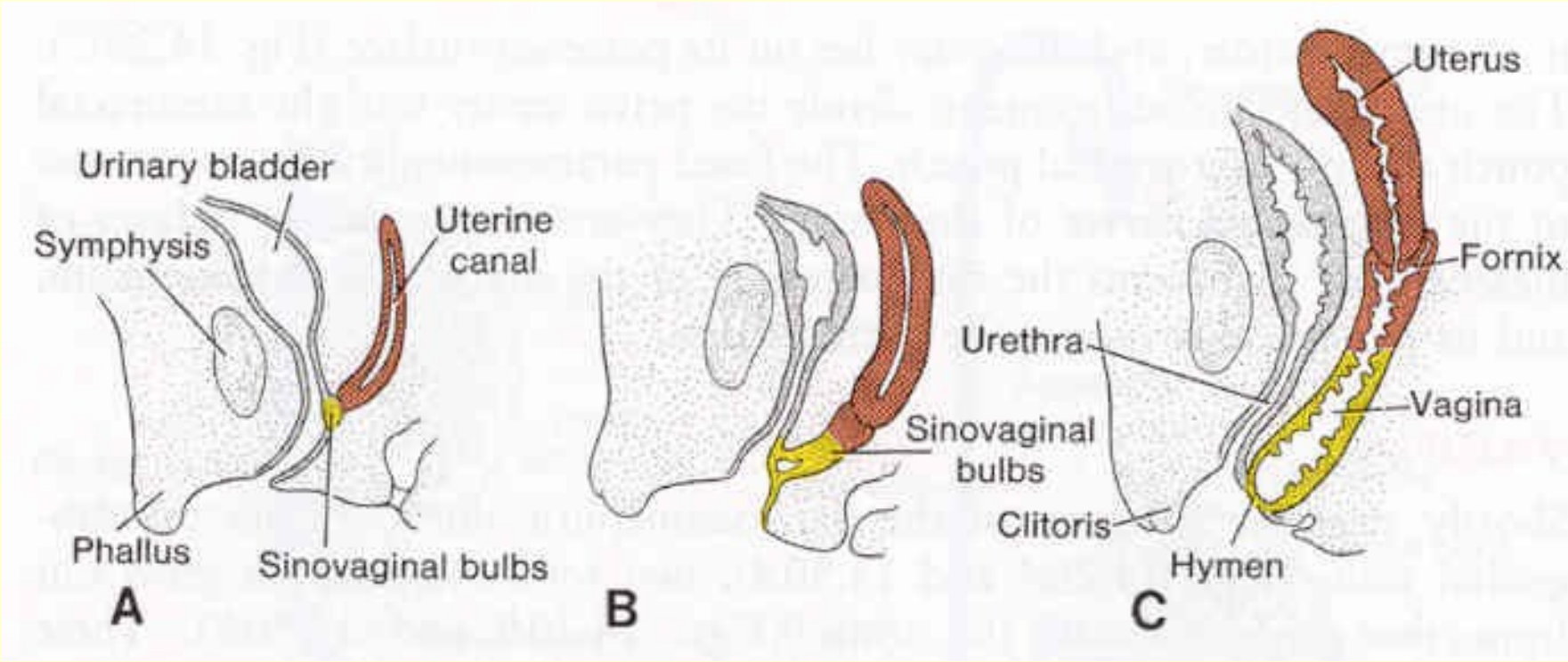
+ extrophia vesicae urinariae

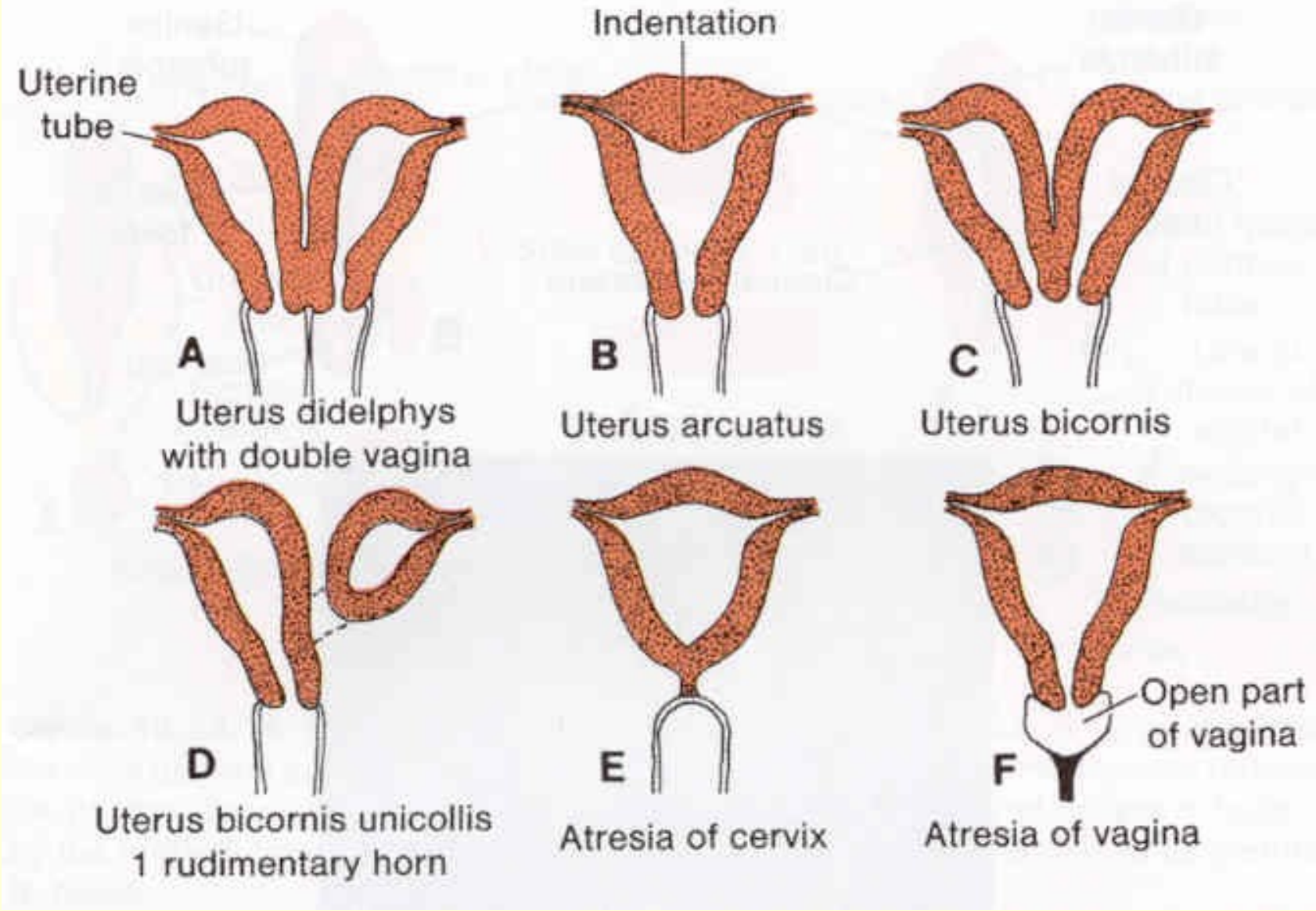




Congnital bilateral inguinal hernia


Uterine tube
Uterine septum
Urogenital sinus
A
Lumen of uterus
Caudal tip of paramesonephric ducts
Tissue of sinovaginal bulbs (vaginal plate)
B
Cervix
Fornix
Vagina
Hymen
C


Urinary bladder
Symphysis
Uterine canal
Phallus
Sinovaginal bulbs
A
Sinovaginal bulbs
B
Uterus
Fornix
Urethra
Vagina
Clitoris
Hymen
C


Uterine tube
A
Uterus didelphys with double vagina
Indentation
B
Uterus arcuatus
C
Uterus bicornis
D
Uterus bicornis unicollis 1 rudimentary horn
E
Atresia of cervix
Open part of vagina
F
Atresia of vagina


End

Repetition of blood

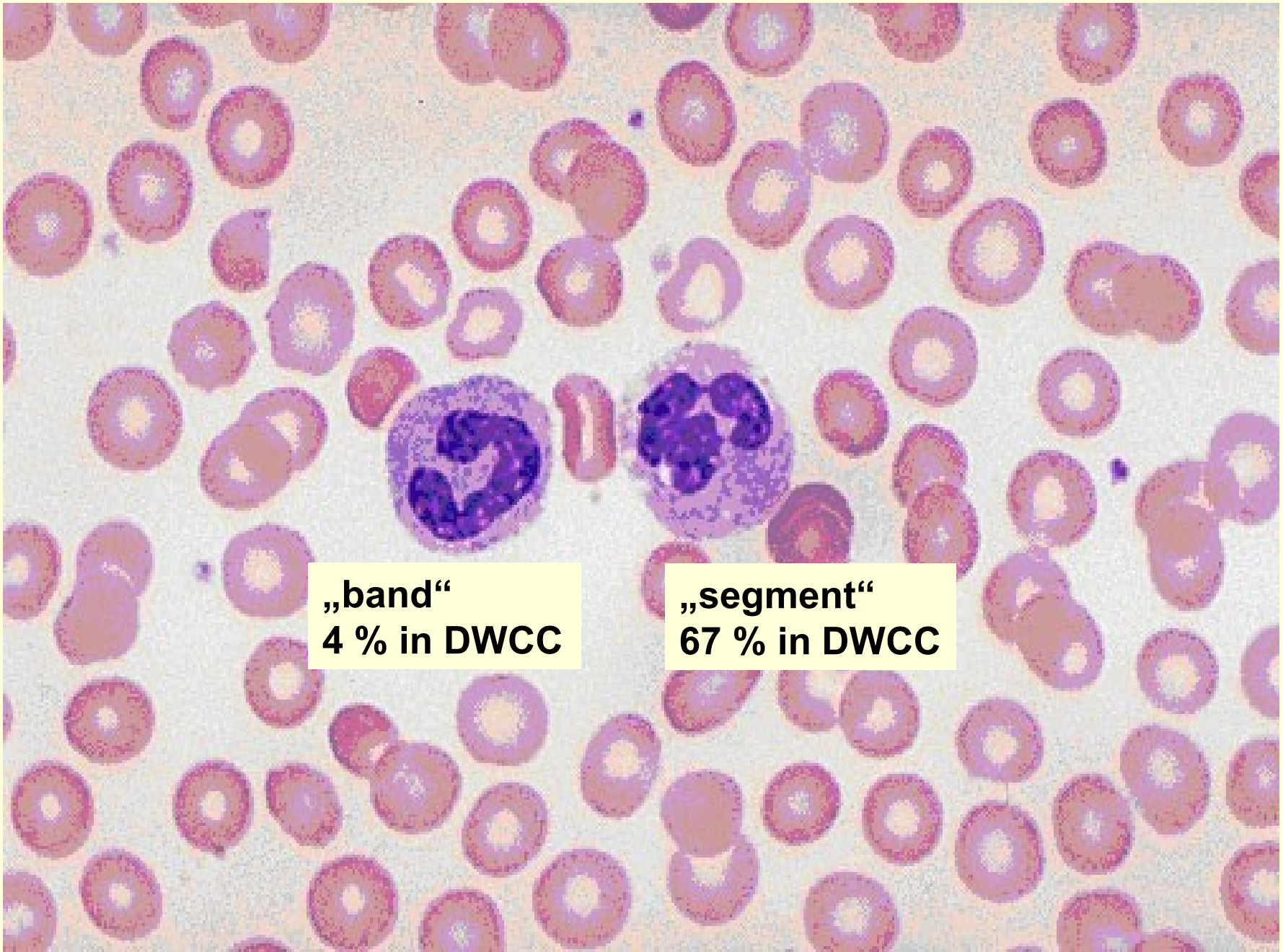
- Composition of the blood
- Hematocrit
- Hemoglobin
- Erythrocytes – shape, size, density per 1 μl
- Reticulocytes
- Anisocytosis
- Poikilocytosis
- Polycythemia (= polyglobulia)

- Granulocytes
- Agranulocytes
- Number of leukocytes per 1 μl
- Anemia
- Leukocytopenia
- Thrombocyte
- Number of thrombocytes per 1 μl
- Hyalomere, granulomere

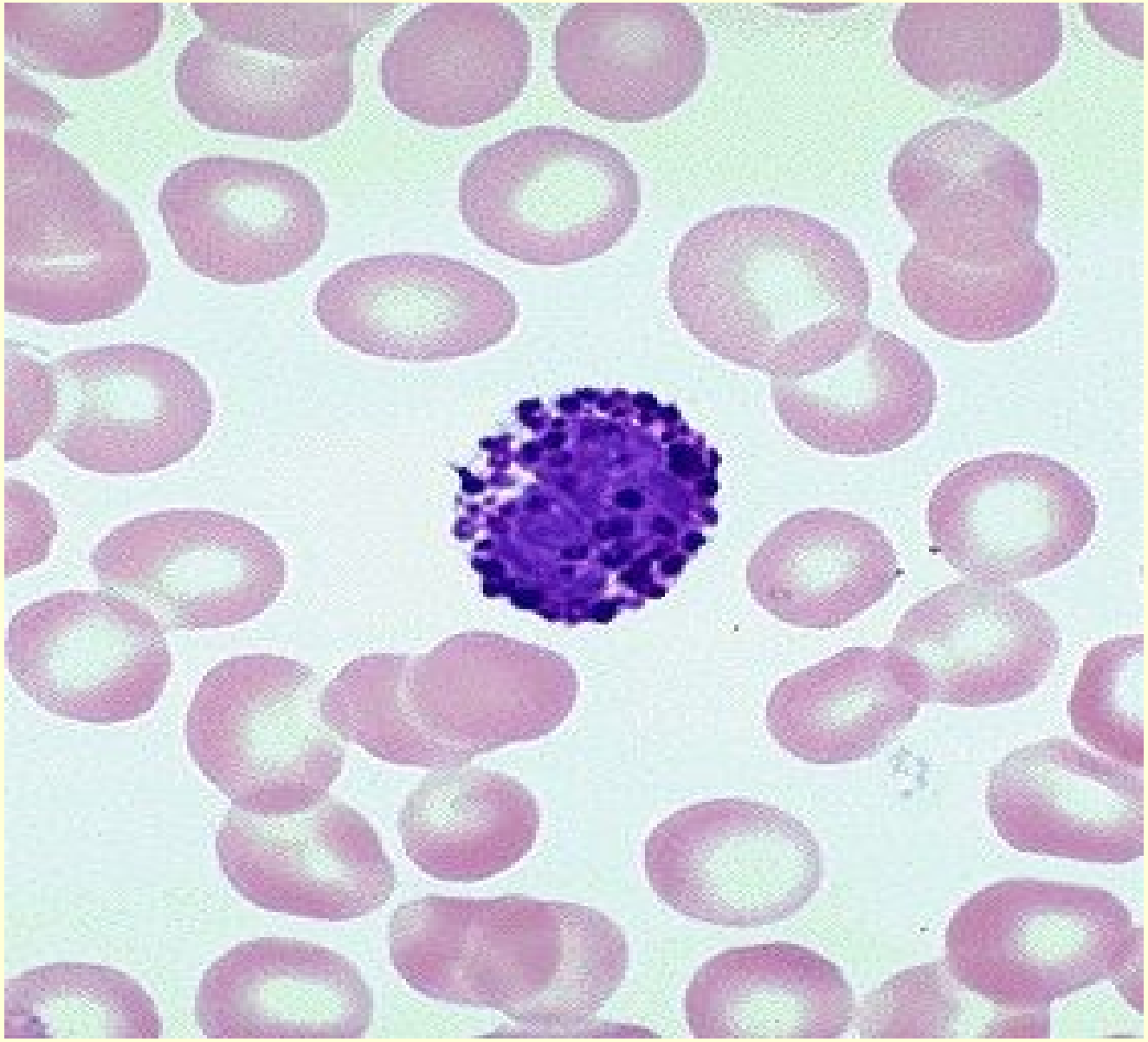
- Bone marrow structure
- Erythropoiesis
- Granulocytopoiesis
- Megakaryocyte
- Endomitosis

- Differential white cell count (DWCC) **!!!**
- Shift to the left or to the right

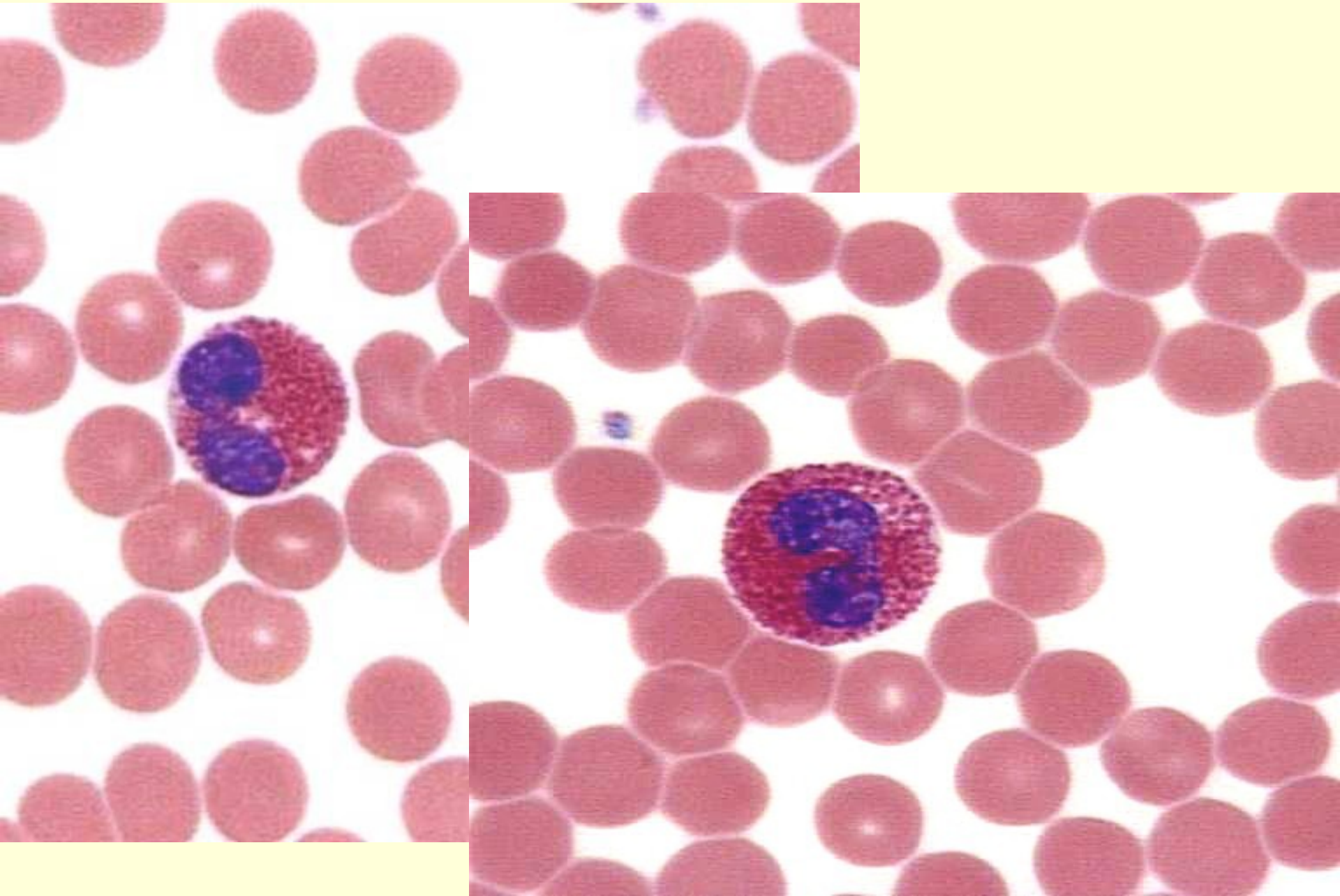
Neutrophilic granulocytes: 10-12 μm in ∅



Basophilic granulocyte: 8 μm in ∅, only 1 % in DWCC



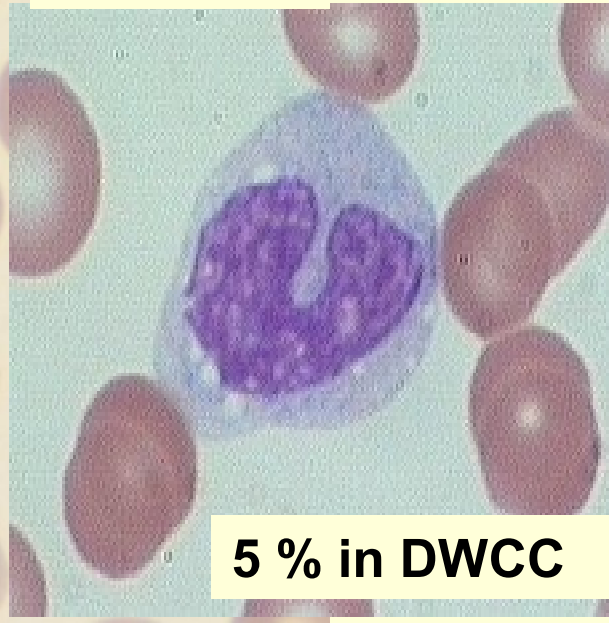
Eosinophilic granulocyte: up to 14 μm in ∅, 3 % in DWCC



Lymfocyte

20 % in DWCC

Monocyte



5 % in DWCC

Thank for your attention