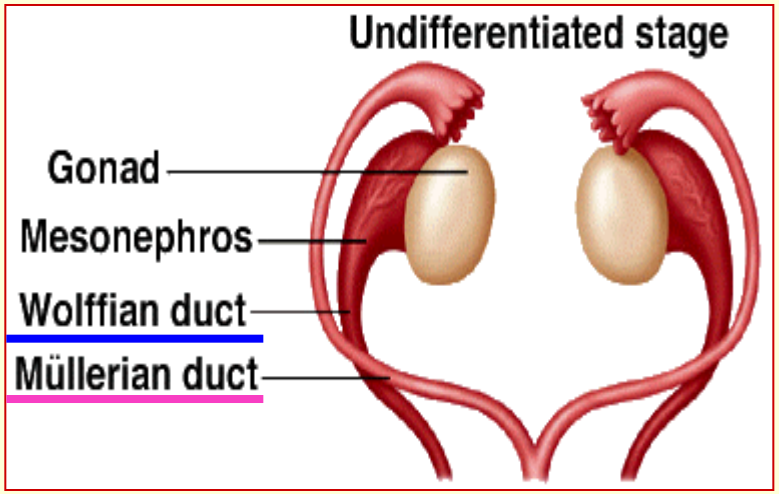
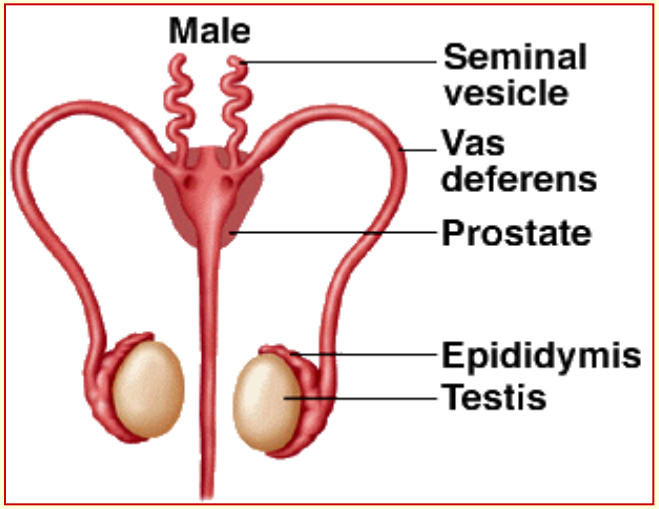
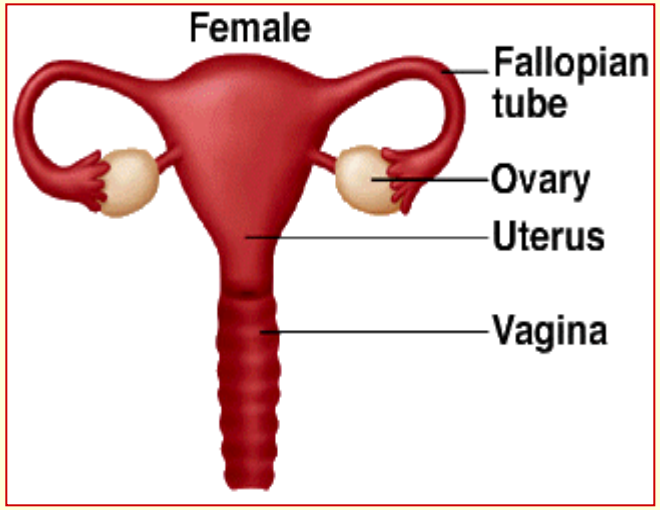
Embryology /organogenesis/

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.

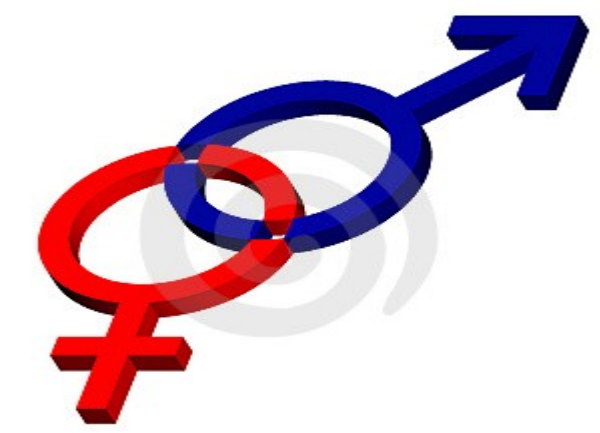
- The **SRY** initiates transformation of indifferent gonads into **testes**, which produce hormones supporting development of male reproductive organs.

- Developed testes produce:

- **testosterone** (T) - stimulates Wolffian ducts development (*epididymis with ductuli efferentes + ductus epididymidis and deferent ducts*)

and

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



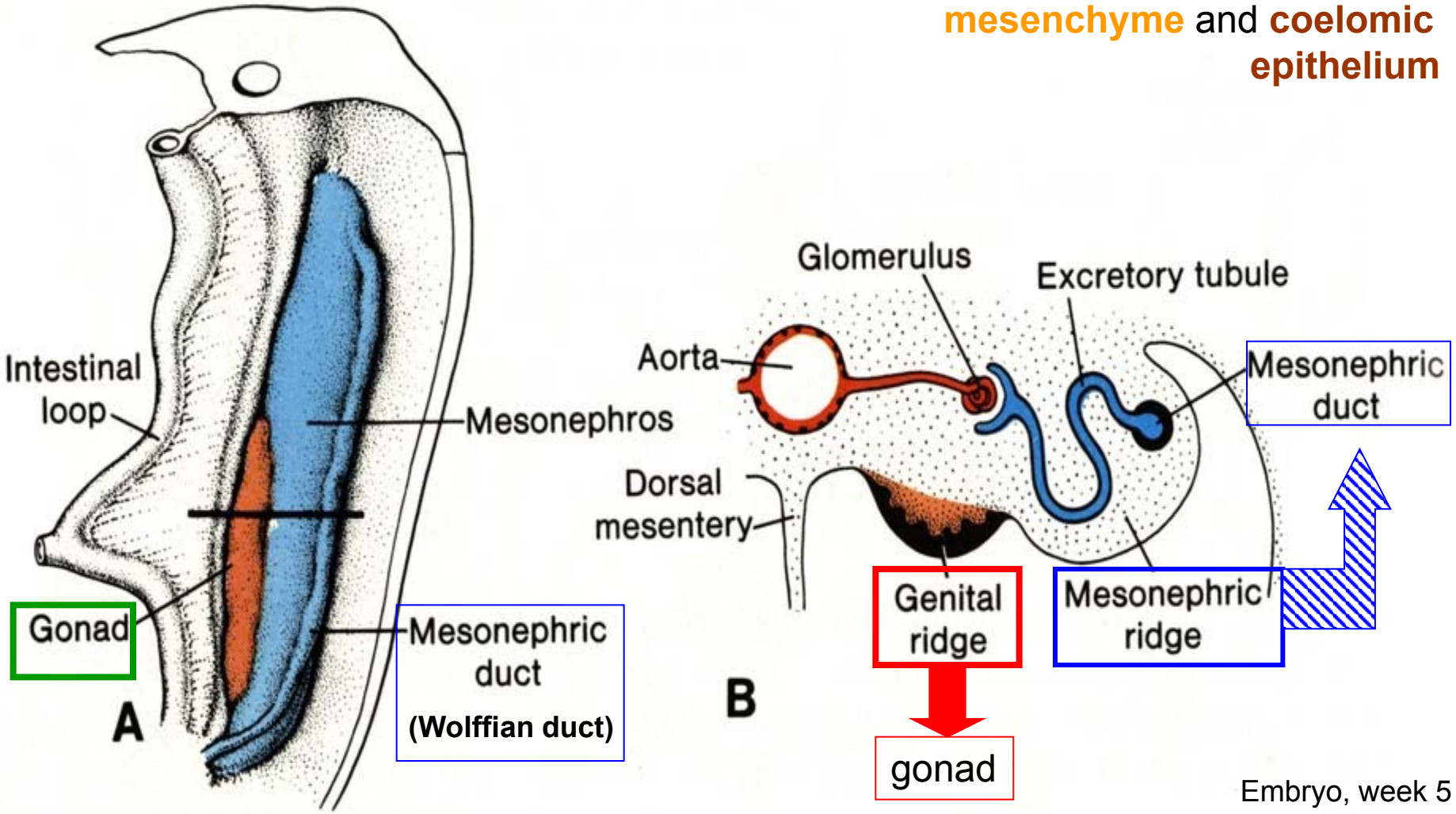
- Indifferent stage – until week 7 - 10
- Differentiated stage

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**



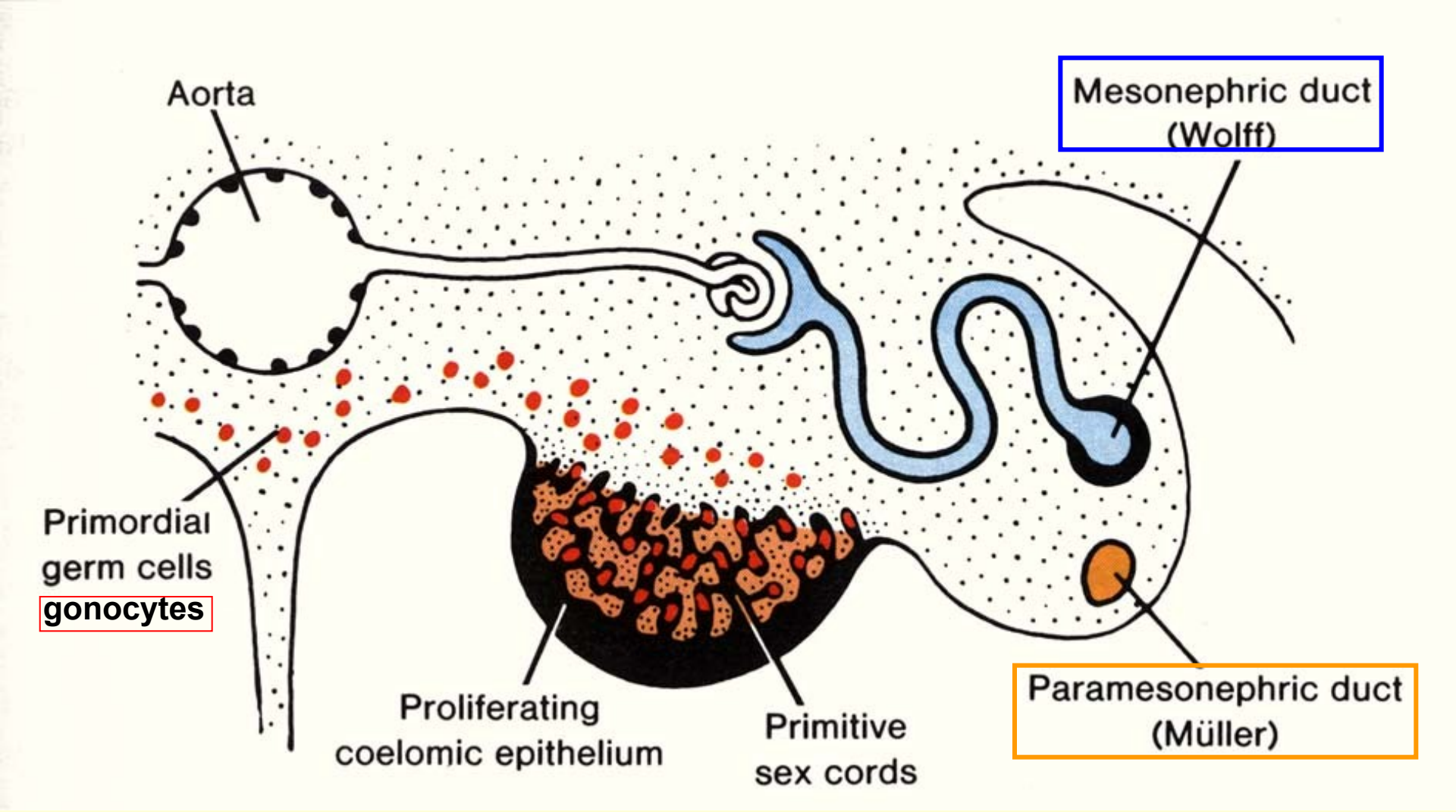
Embryo, week 5

Three sources of gonad development:

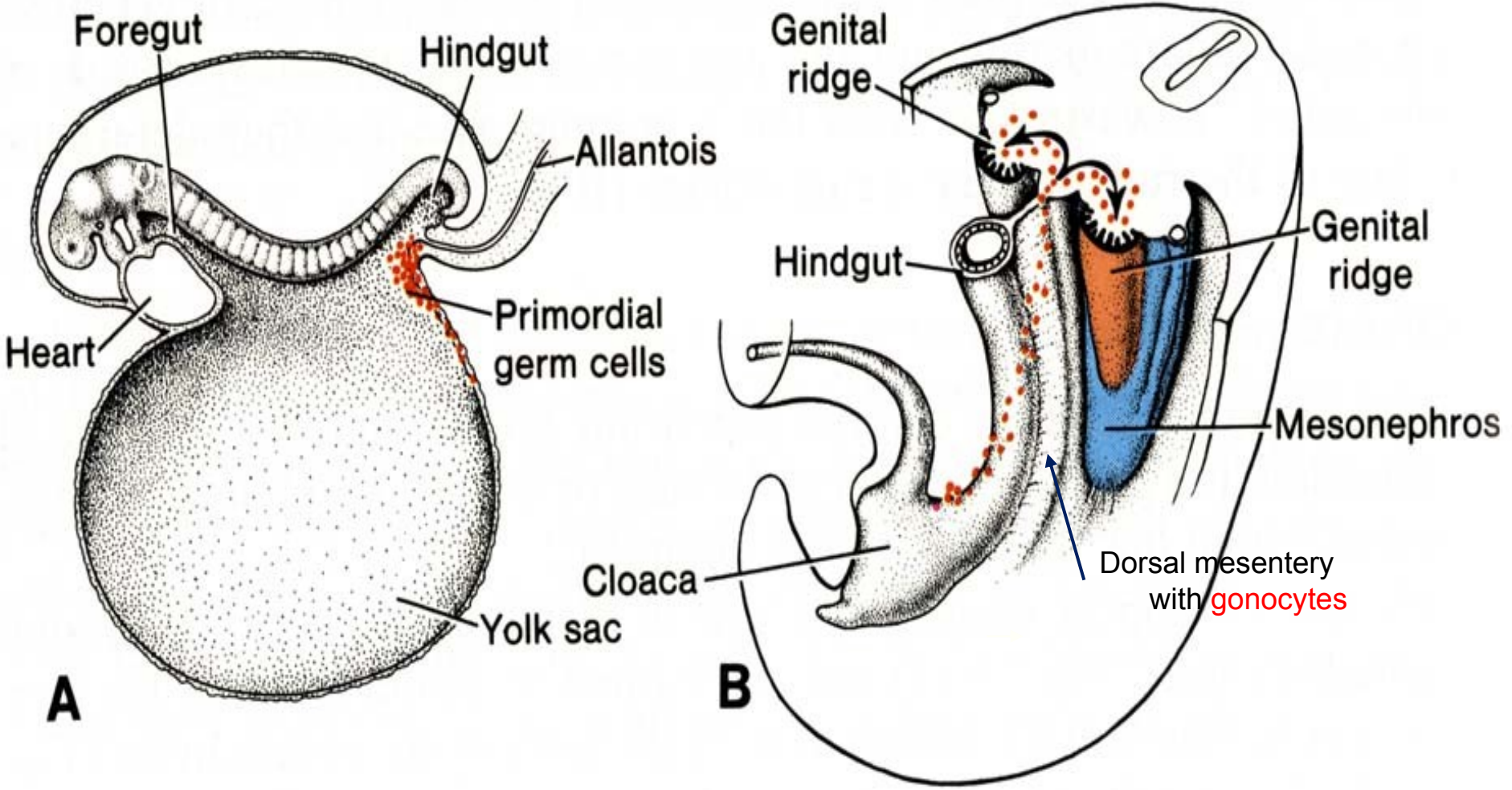
1 – mesenchyme of gonadal ridges (plica genitalis)

2 – coelomic epithelium (mesodermal origin)

3 – gonocytes (primordial cells)



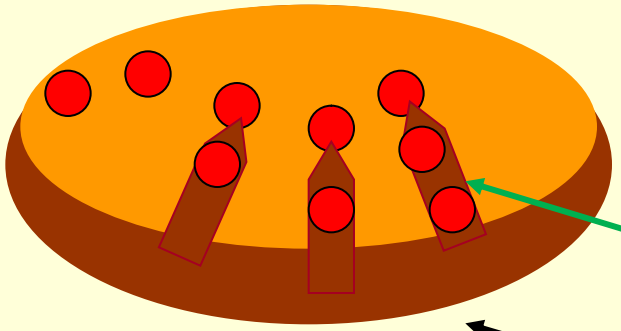
Primordial germ cells – gonocytes – in endoderm of dorsal wall of yolk sac. Gonocytes migrate along dorsal mesentery of hindgut into the gonadal ridges and induce (!) gonad development.



Embryo, weeks 4-6

Indifferent gonad development

- Gonocytes induce coelomic epithelium to proliferate - **primary proliferation**

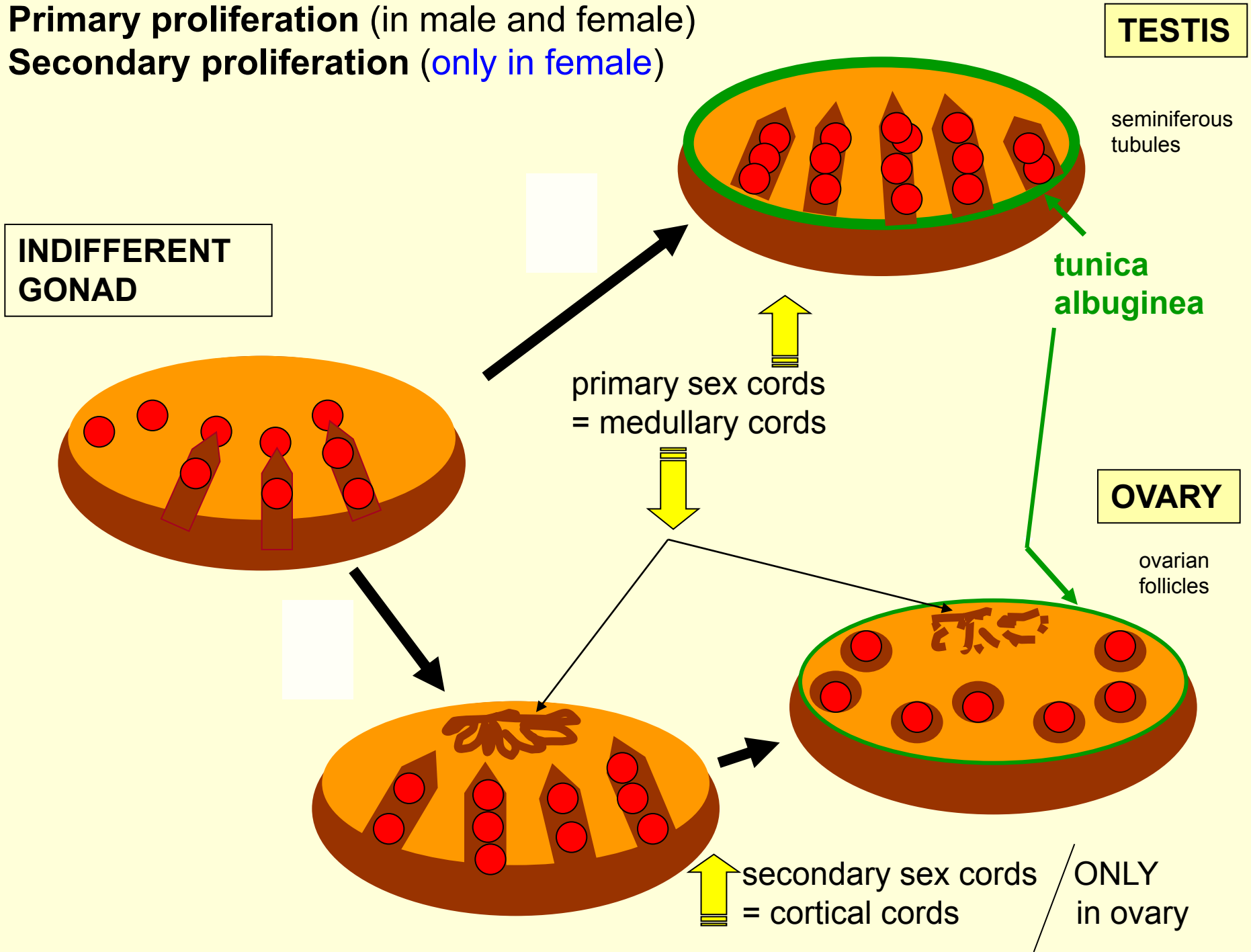


gonocytes, **cells of coelomic epithelium** in **mesenchyme** form together:

primary sex cords

coelomic epith. proliferates and forms cords in mesenchyme of indifferent gonad,gonocytes invade cords.

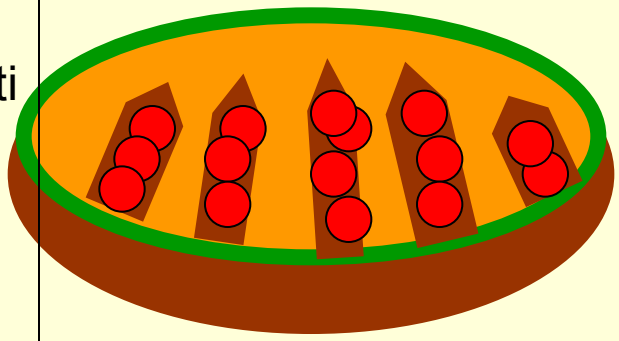
Primary proliferation (in male and female)
Secondary proliferation (only in female)



TESTIS:

Primary sex cords ⇨ tubuli semuniferi contorti

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

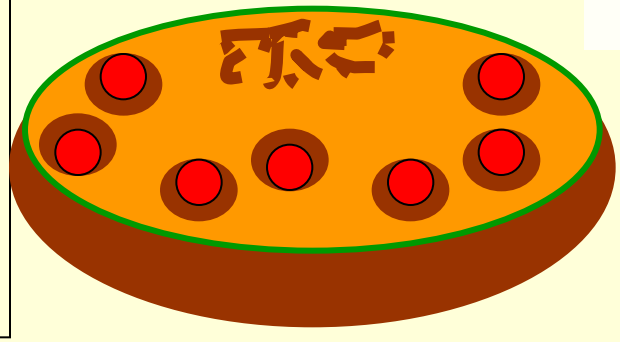


Mesenchyme ⇨ tunica albuginea

OVARY:

Primary sex cords ⇨ degenerate in ovarian medulla

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

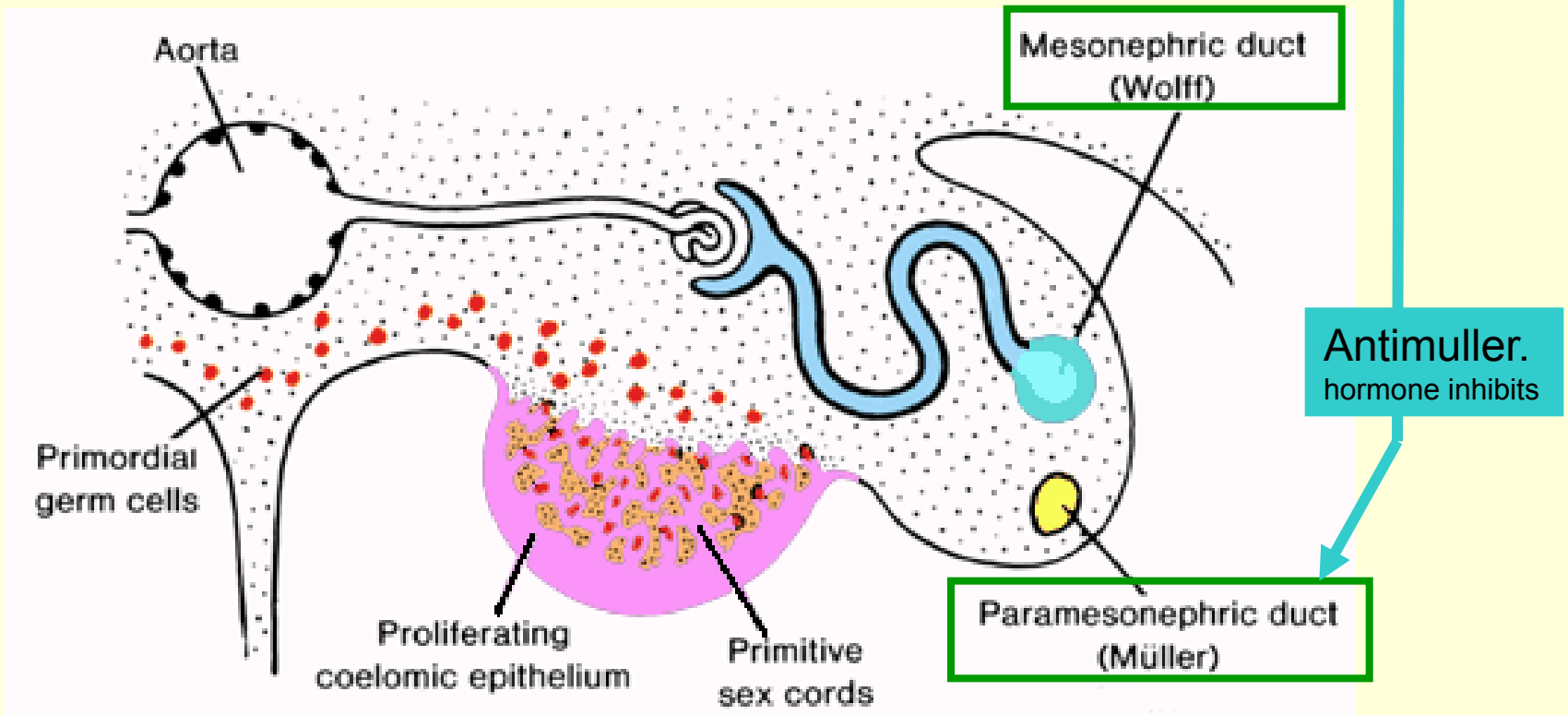


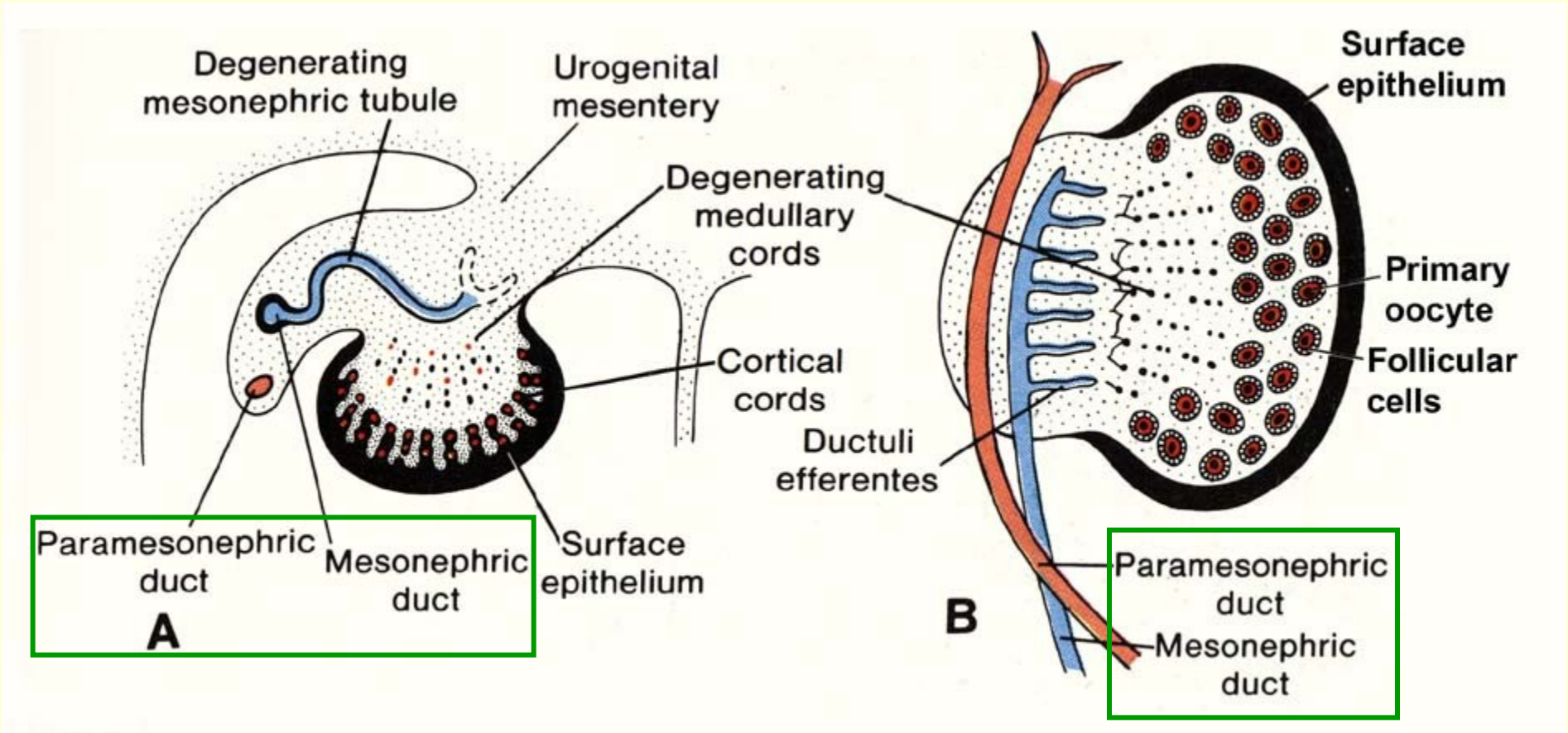
Development of reproductive passages
(indifferent – differentiated stage)

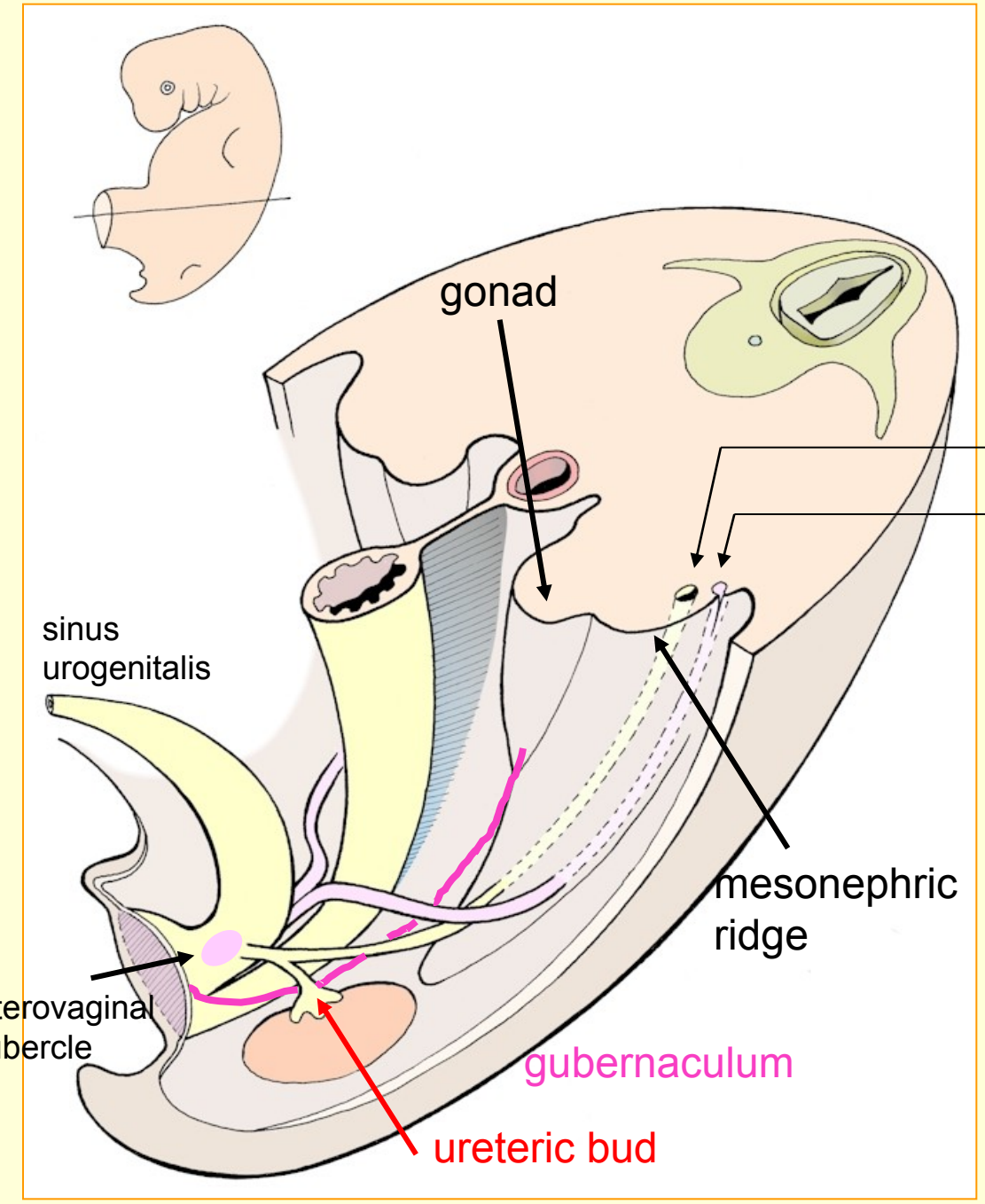
- In mesonephric ridge – 2 ducts:

Ductus mesonephricus (Wolffi)

Ductus paramesonephricus (Mülleri)

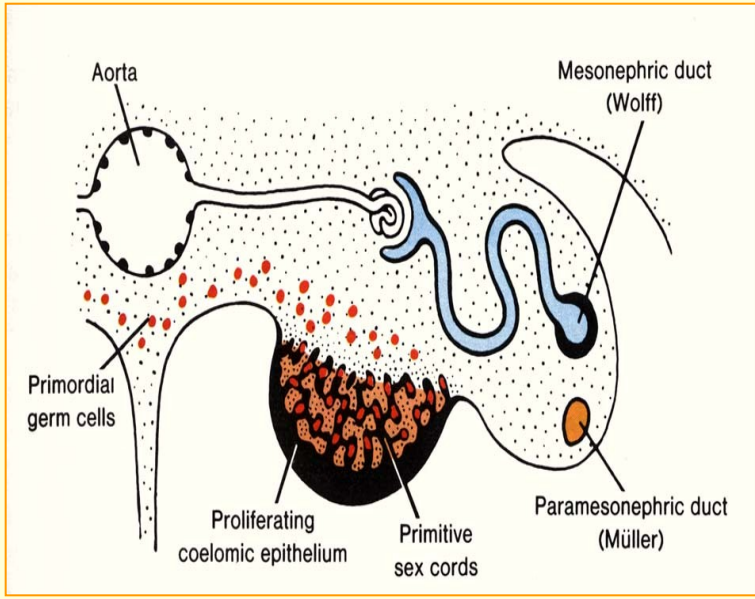



Degenerating mesonephric tubule
Urogenital mesentery
Degenerating medullary cords
Cortical cords
Paramesonephric duct
Mesonephric duct
Surface epithelium
A
Surface epithelium
Primary oocyte
Follicular cells
Ductuli efferentes
Paramesonephric duct
Mesonephric duct
B



Indifferent stage:

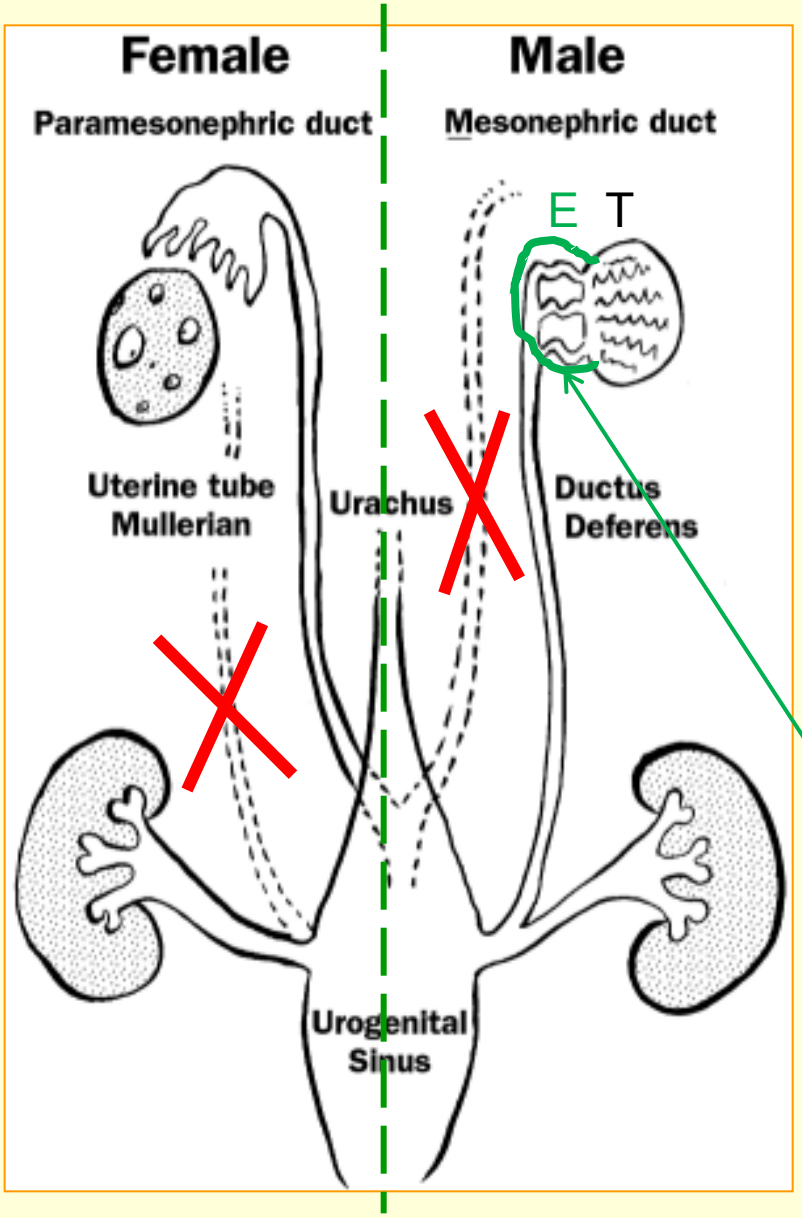
Wolffian duct
Müllerian duct



Differentiated stage of development:

Müllerian duct:

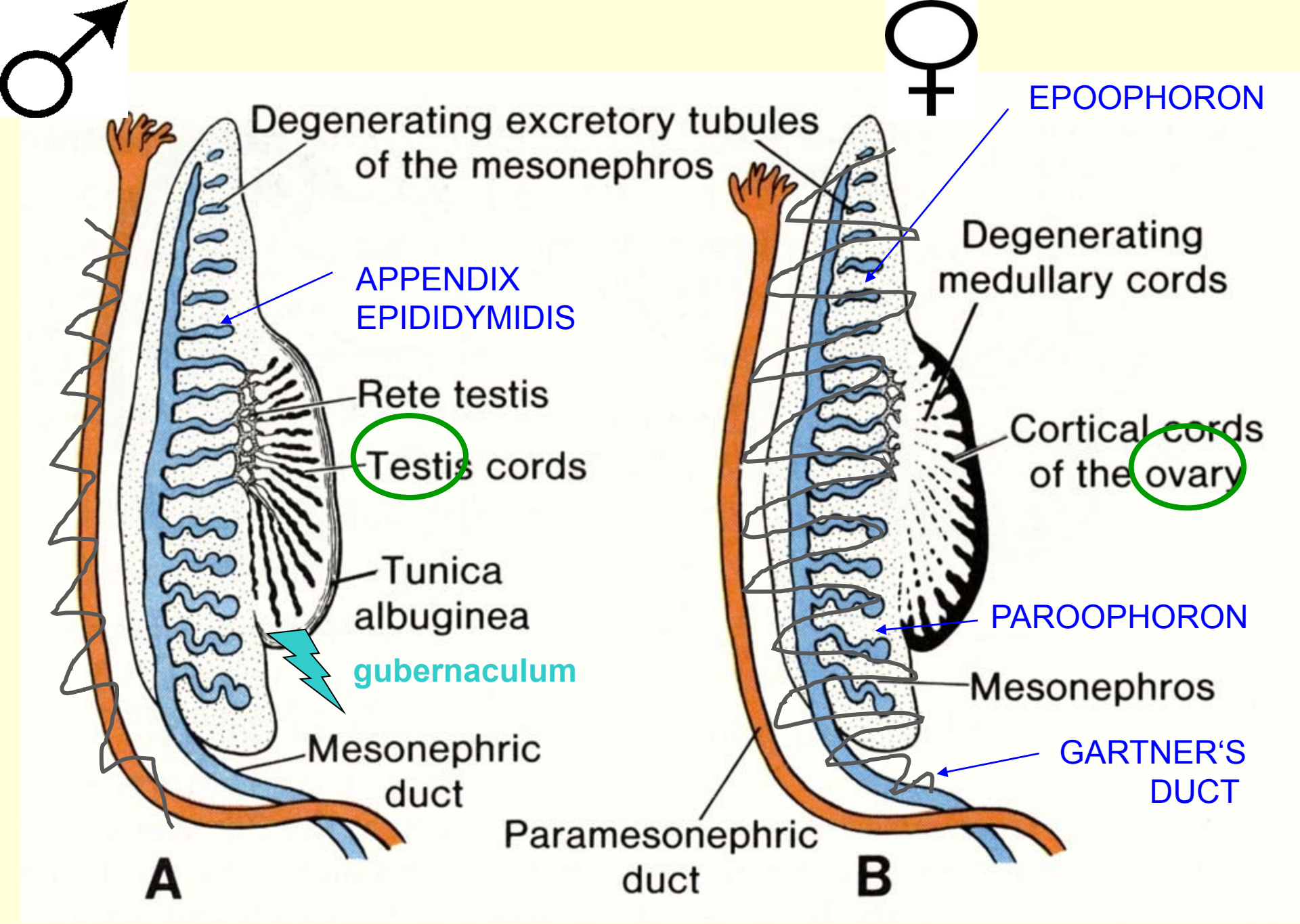
Oviduct
Uterus
Cranial part of vagina



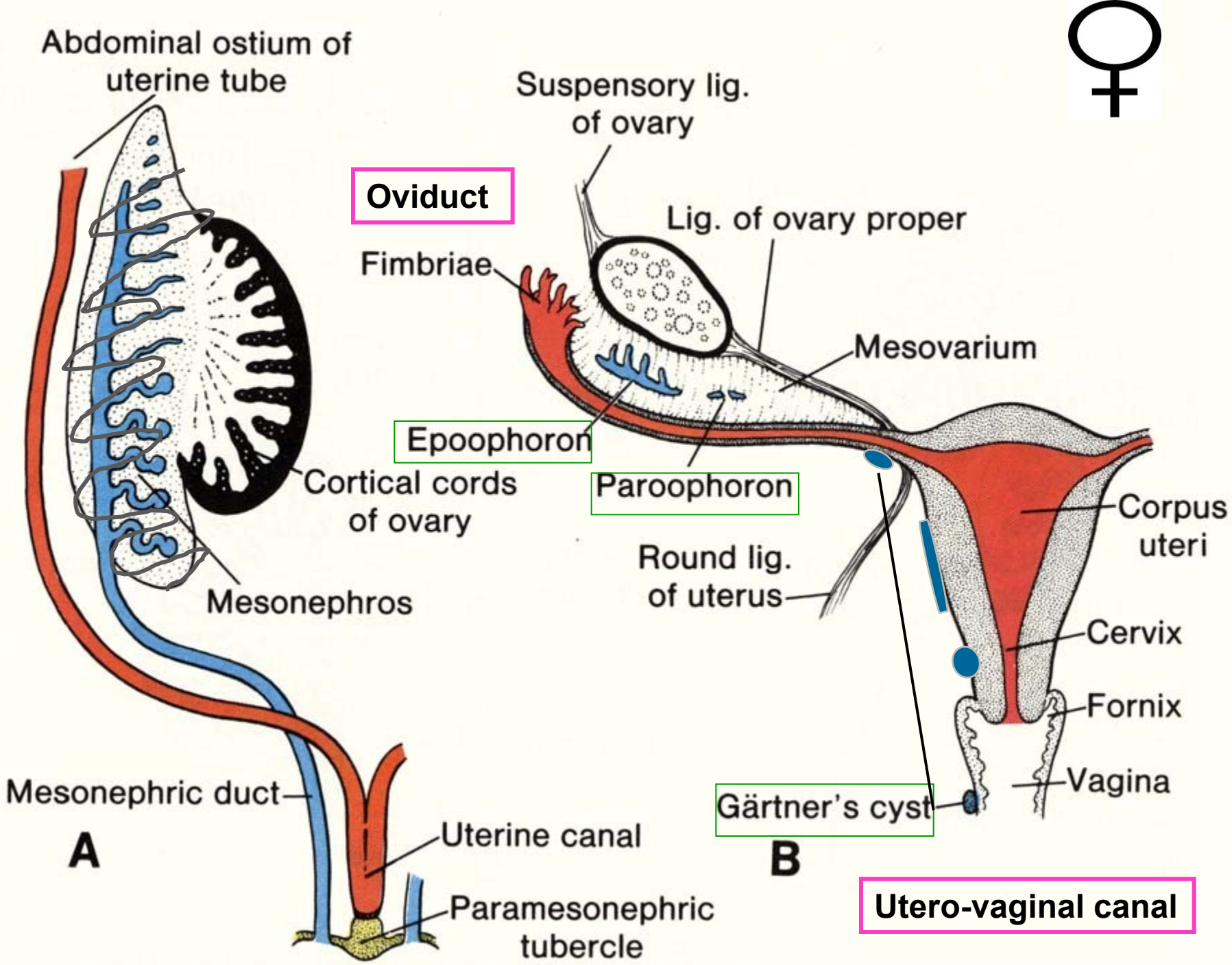
Wolffian duct:

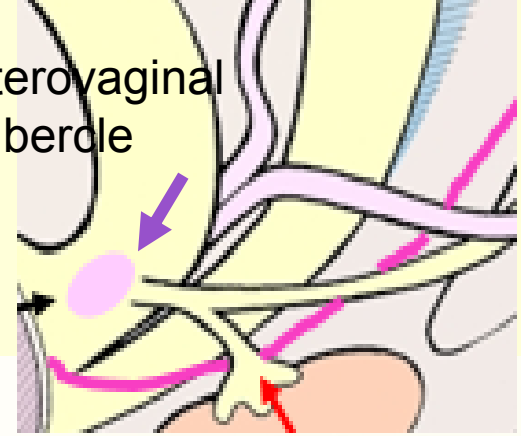
Ductus epididymidis
Ductus deferens
Ductus ejaculatorius

Ductuli efferentes in epididymis and rete testis originate from mesonephric tubules



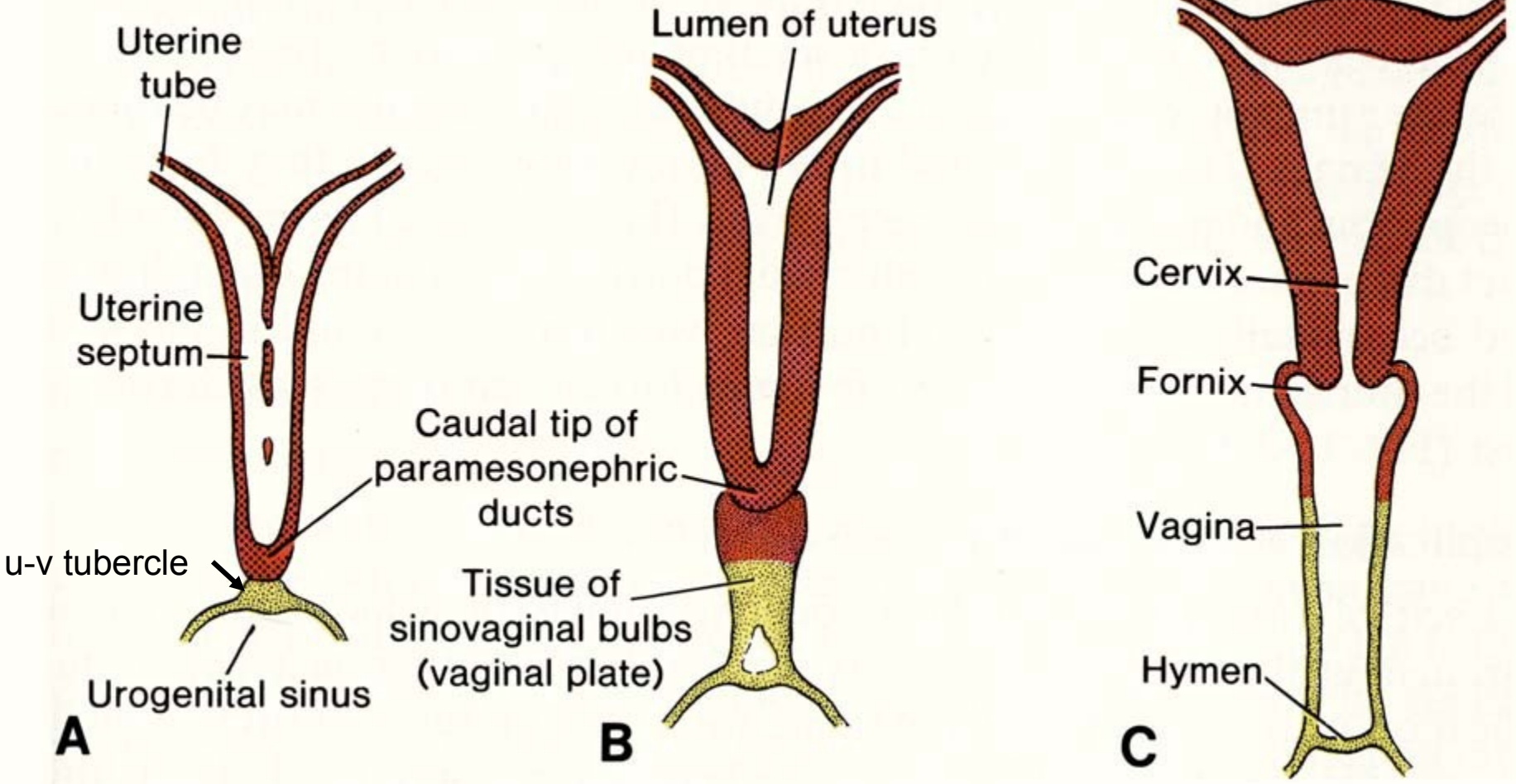
+ RUDIMENTARY STRUCTURES


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
Uterine canal
Paramesonephric tubercle
A
B
Utero-vaginal canal

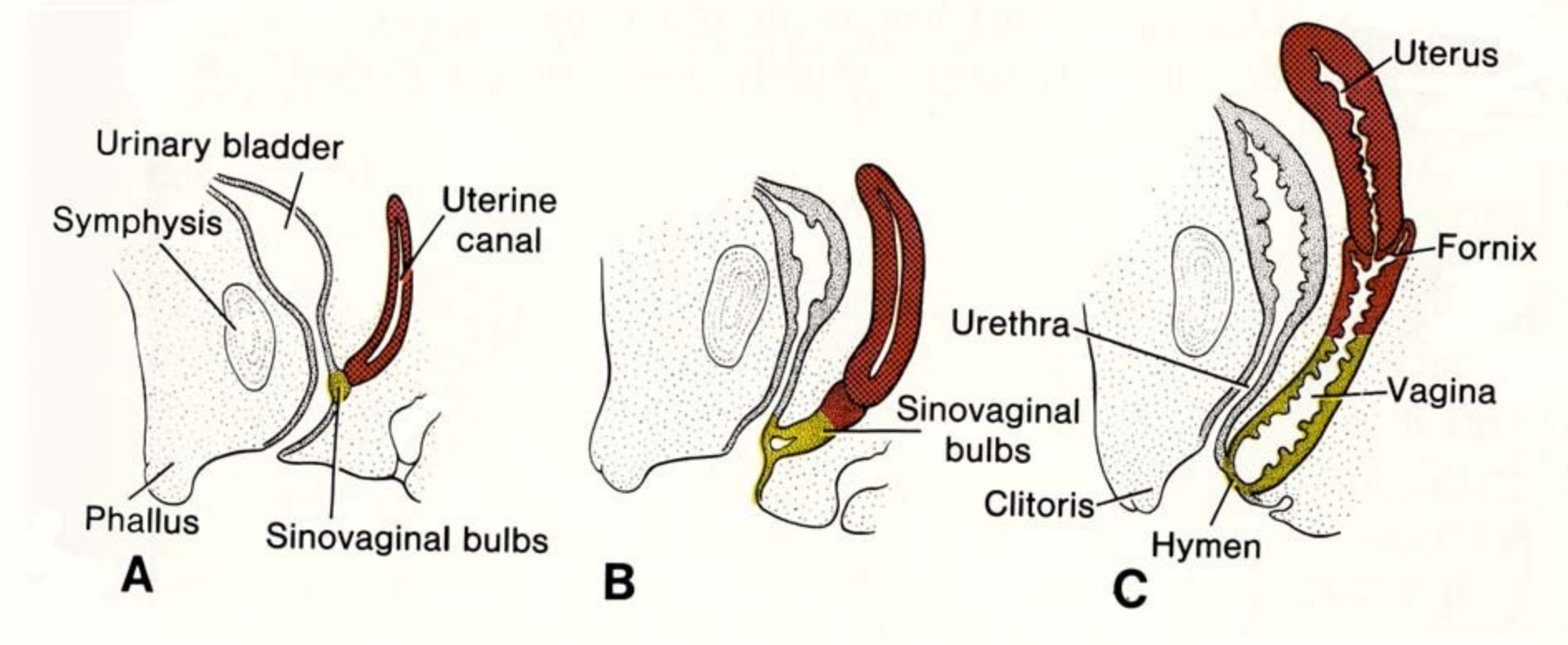


dorsal view

UTEROVAGINAL CANAL



side view


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

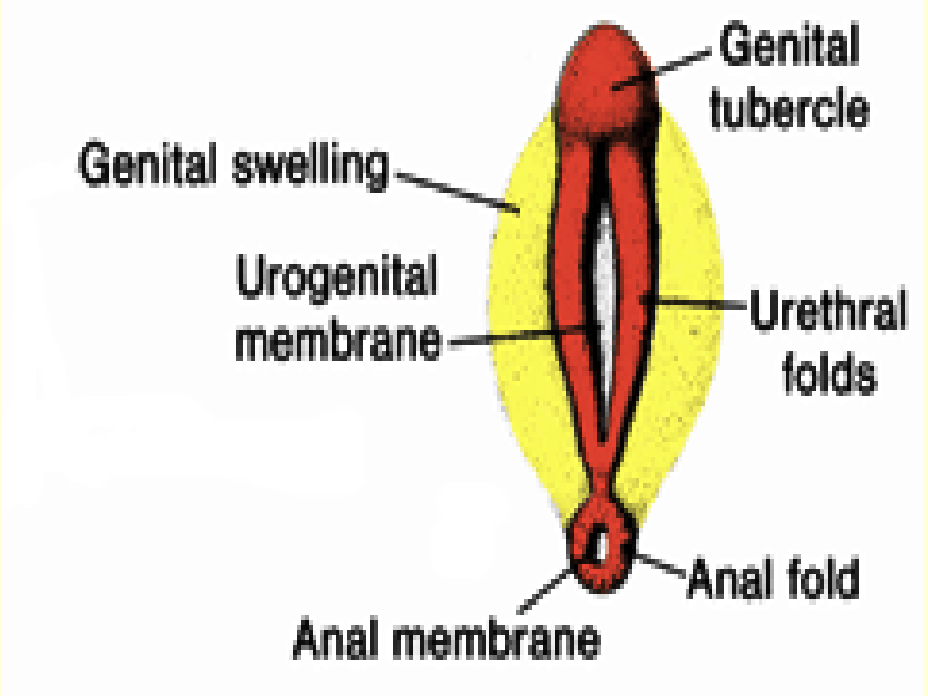
[tuberculum genitale]

*Urethral (cloacal) folds

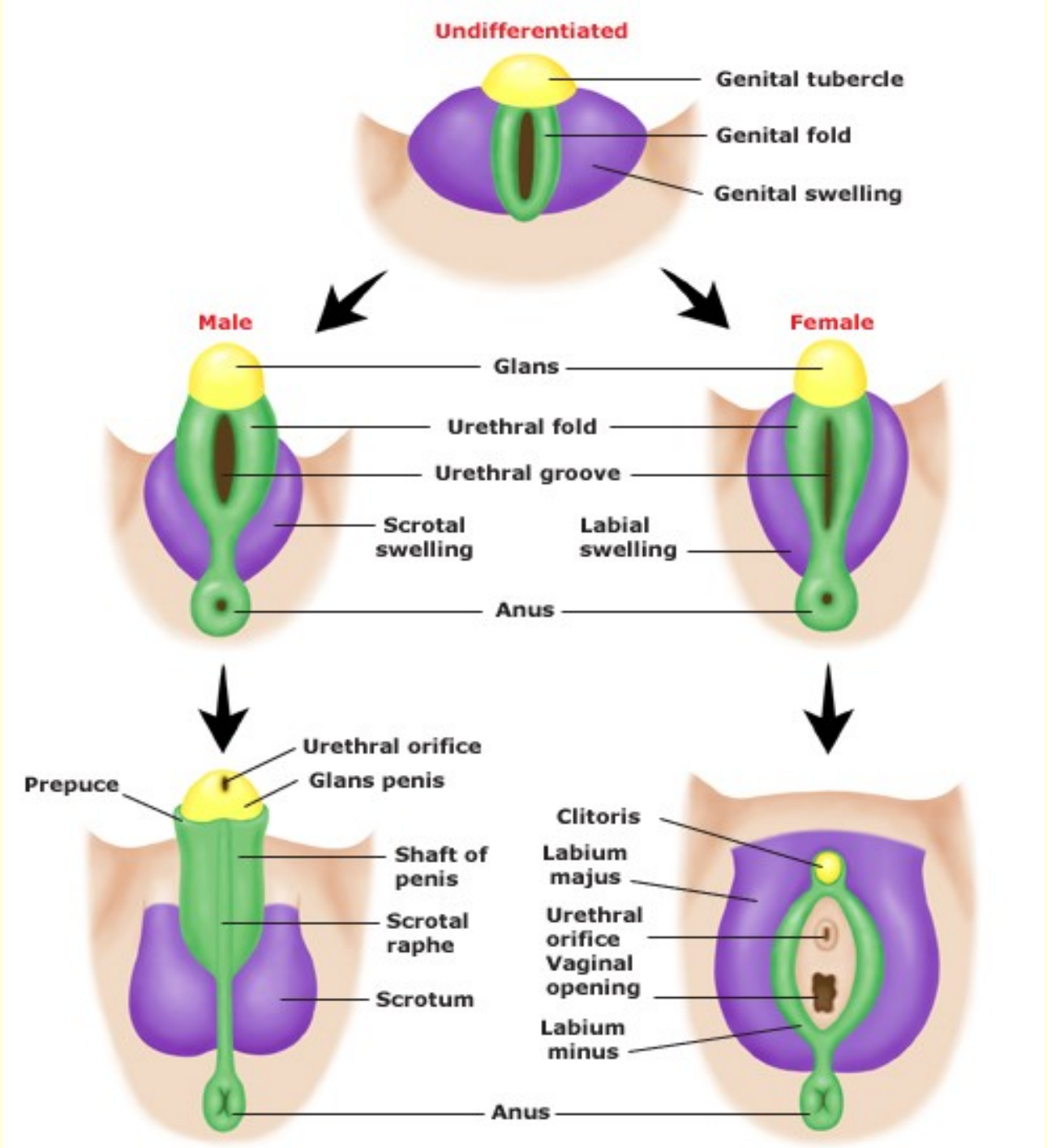
[plicae genitales]

Labio-scrotal swellings

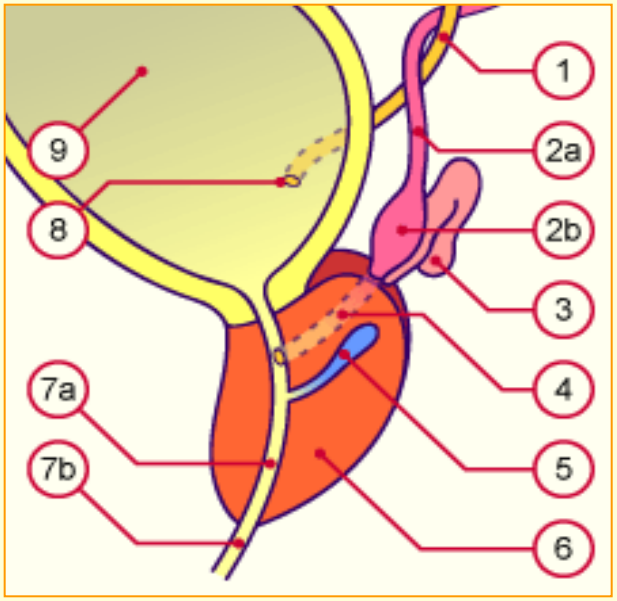
[tori genitales]



*urogenital folds


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

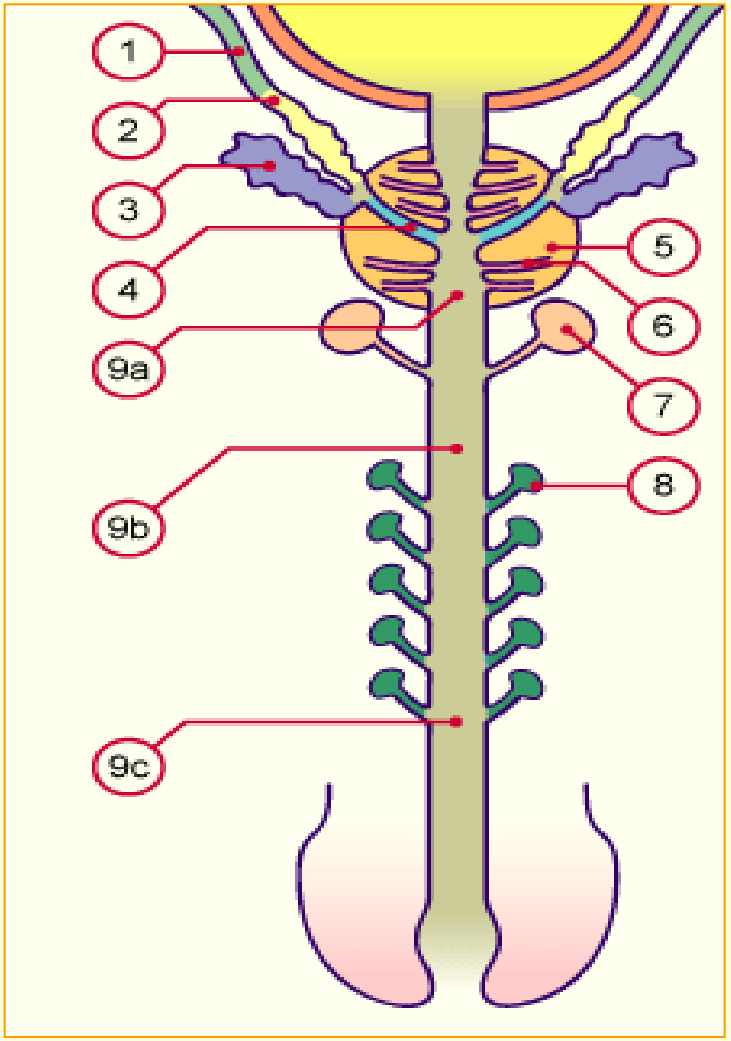
Accessory glands development



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

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

Bulbourethral and Litré‘s glands

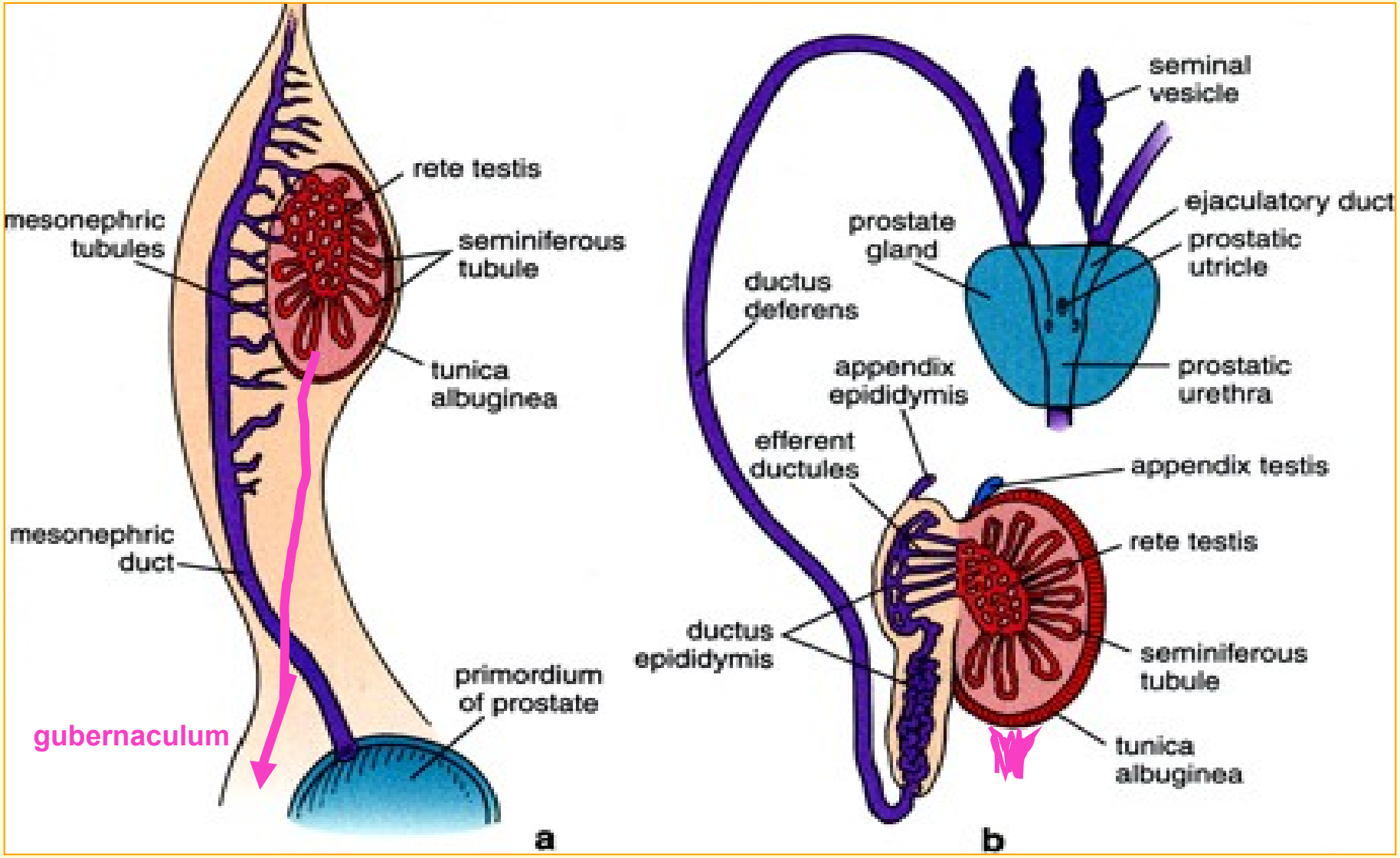


Position of gonads during development

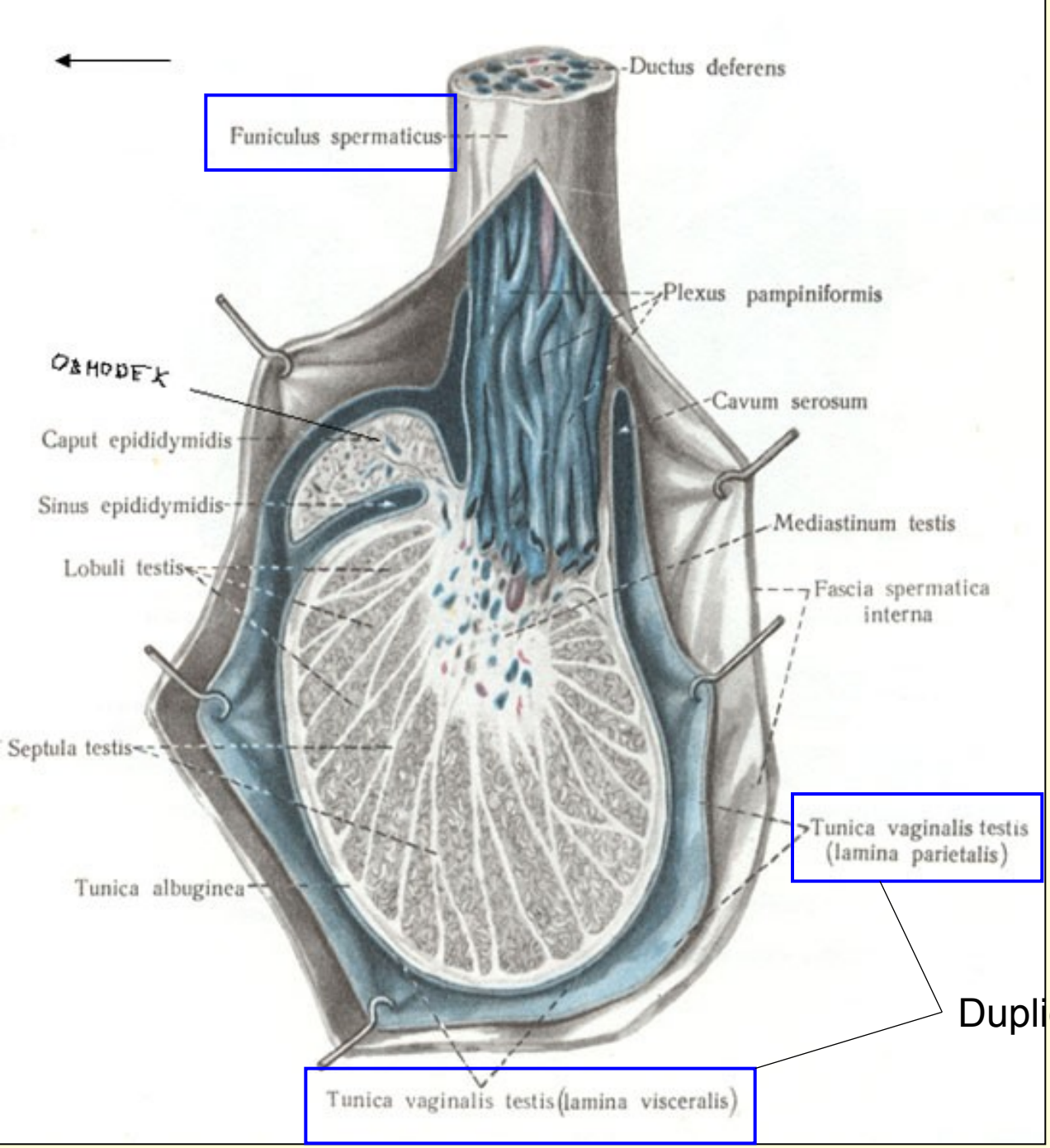
- Gonad develops in only short, lumbal part of genital (gonadal) ridge (Th6 – S2)
- Cranial part - disappeares
- Caudal part transforms into gubernaculum

- 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

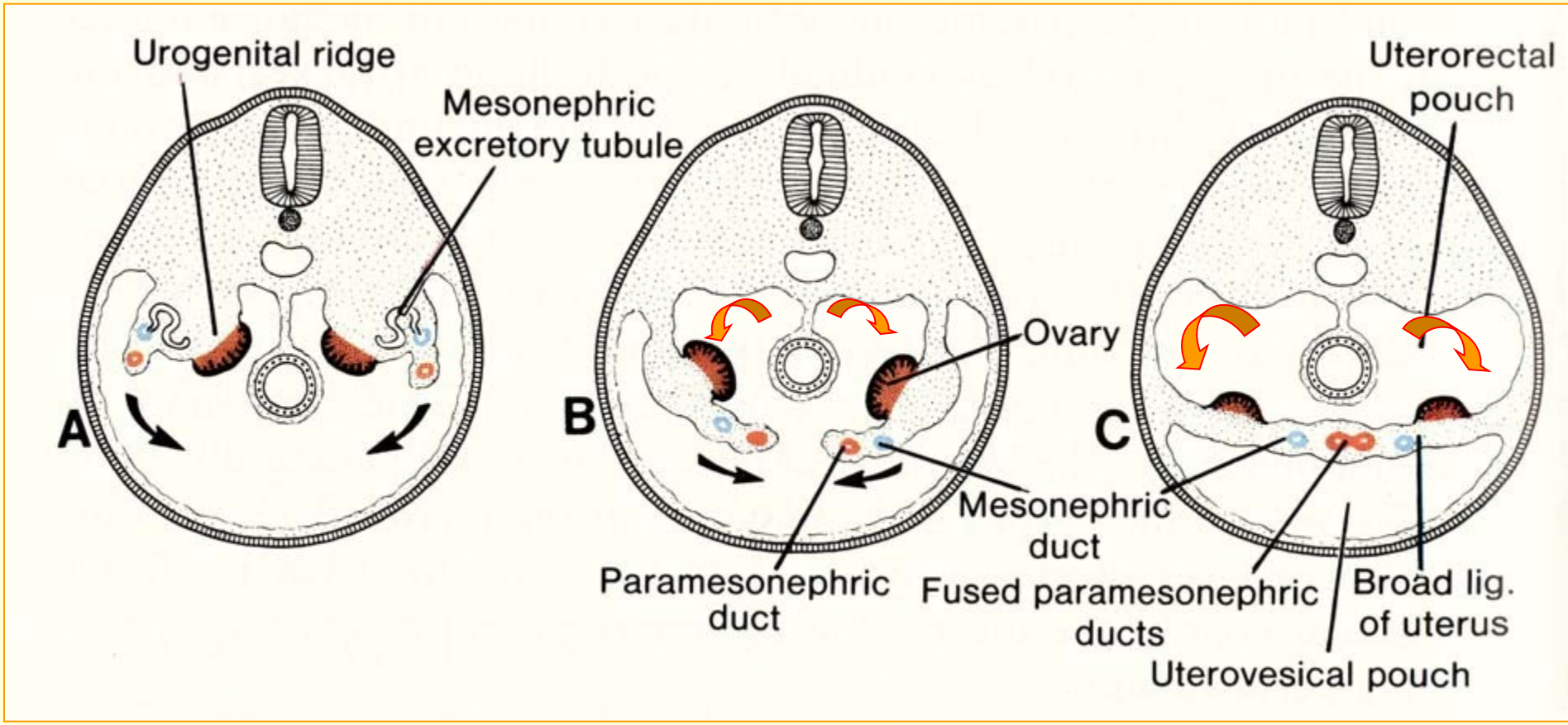


At the bottom of scrotum (male) or labia majores (female)



Duplicature of peritoneum

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



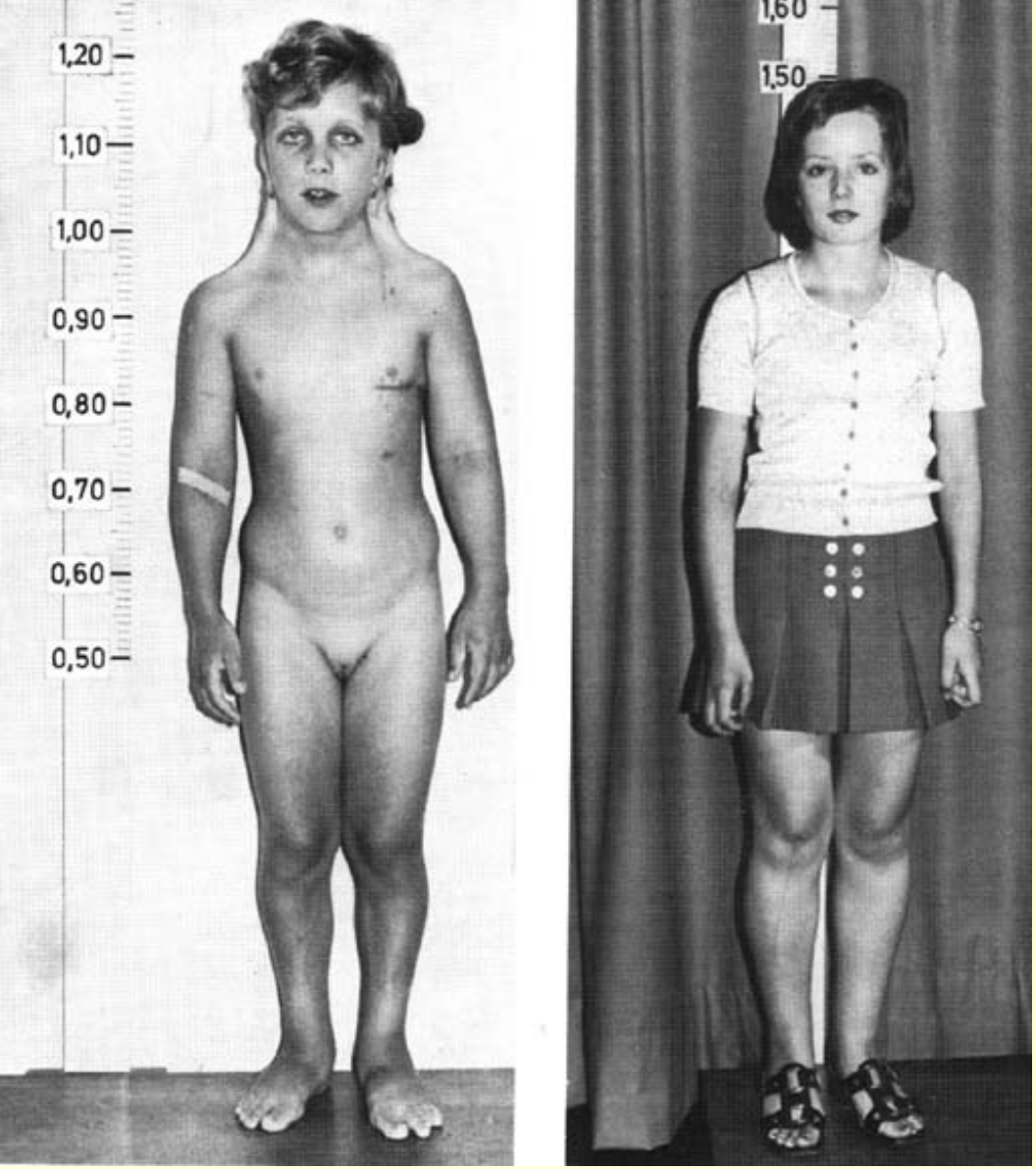
Congenital malformations - 1

- **Genetic anomalies**: total manifestation
- Gonad(s) agenesis – gonocytes did not reach genital ridge
- 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 45/X0 – absent X chr.

(girl - 15 years,150 cm)

pterygium coli, hair border is low



Turner syndrom

Before and after hormonal and surgical therapy

Klinefelter syndrom (47/XXY) – X more

19 years, 180 cm

infertility
gynekomastia,

HERMAFRODITISMUS

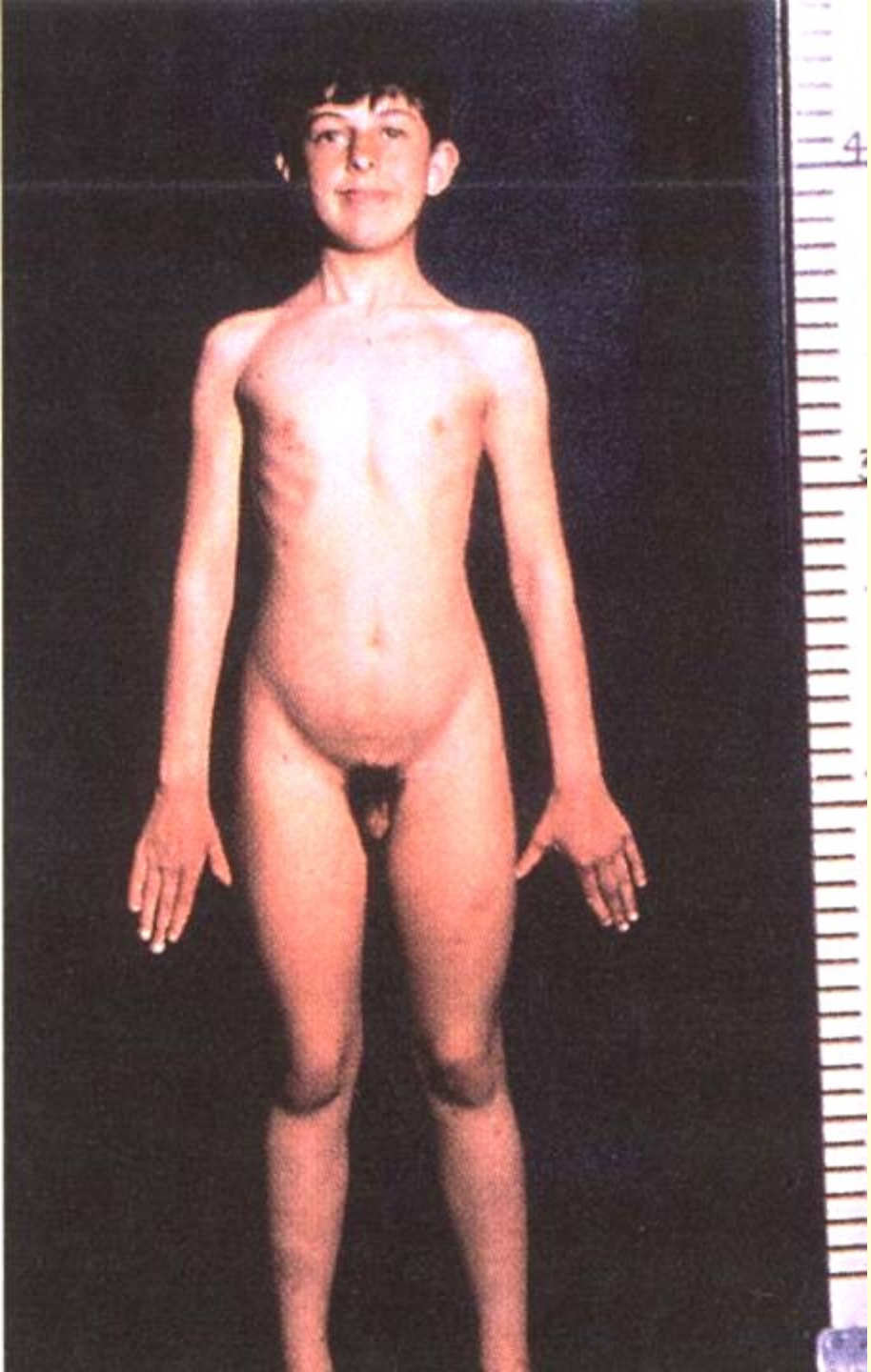
(intersexuality)

chromosomal mosaicisms

- genotype: **45,X/46,XY** **(70 %)**
  45,Y/46,XX (20 %)
  47,XXY/46,XX (10 %)
- gonads: **ovotestis** uni- or bilaterally;
- or (**ovary** on one side and **testis** on the other side)
- etiology: deffect in sex chromosomes separation during zygote cleavage

- fenotype:

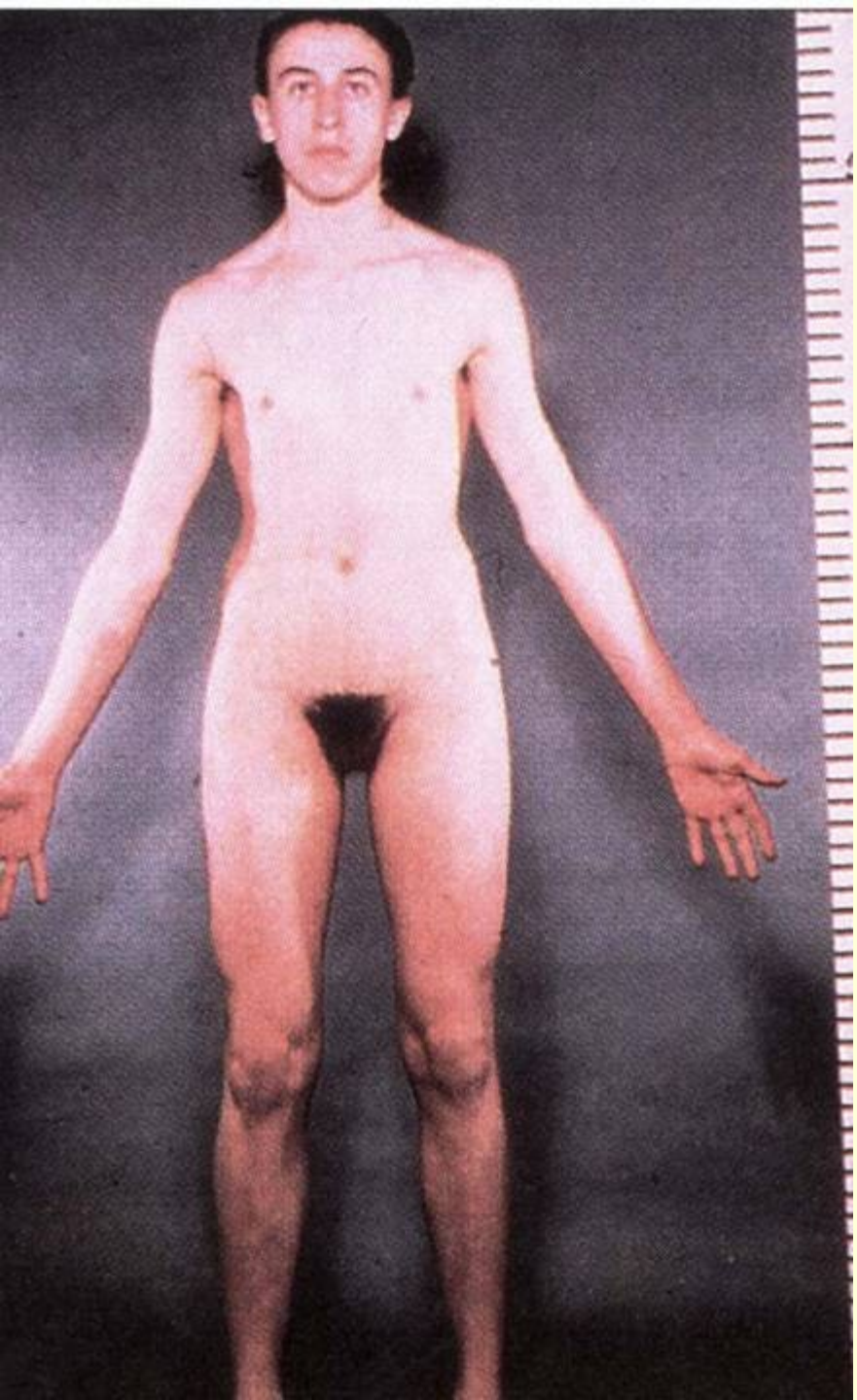
„*almost normal woman – almost normalman*“



Pseudohermafroditismus femininus

(girl, 12 years)

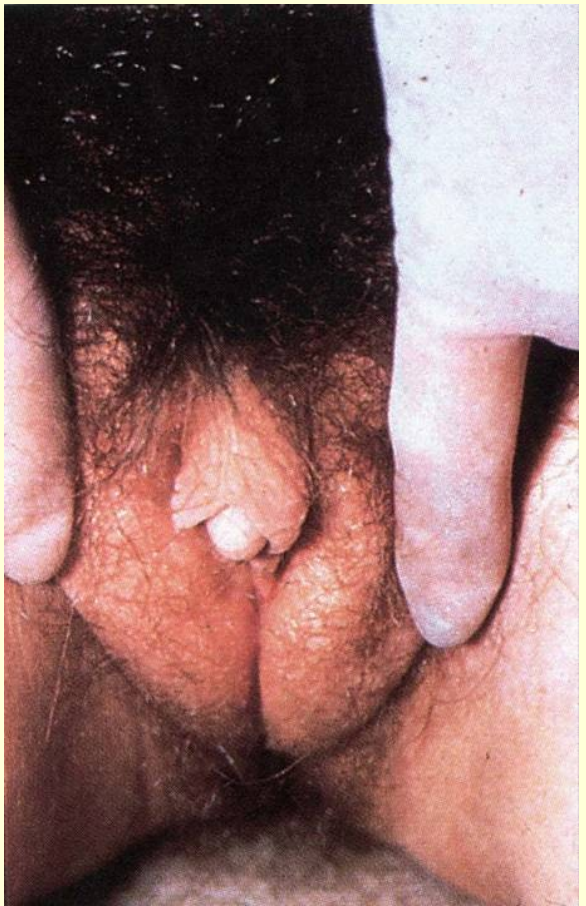
ovaries, fenotype rather male



Pseudohermafroditismus masculinus

(17 years)

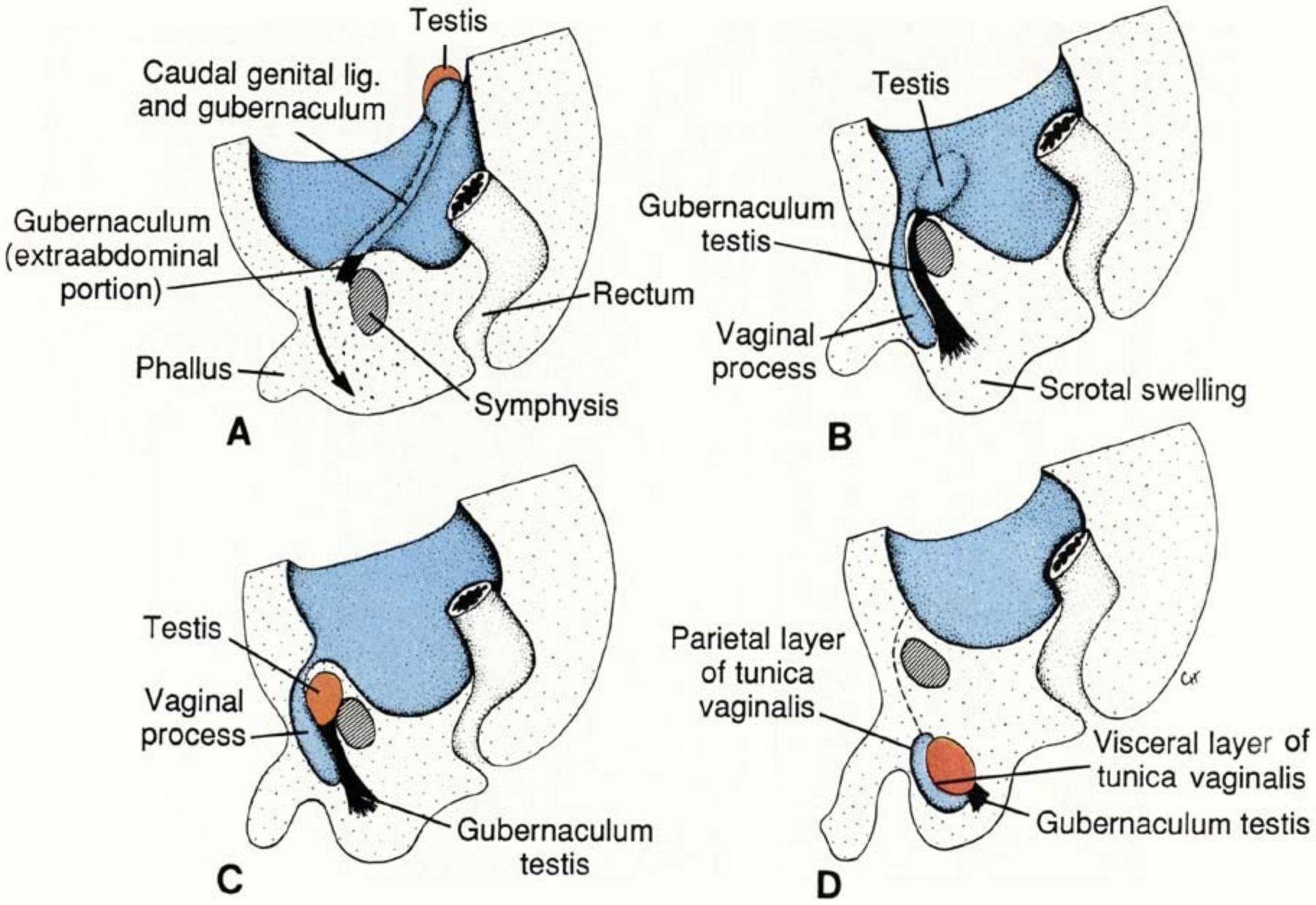
testes, fenotype rather female



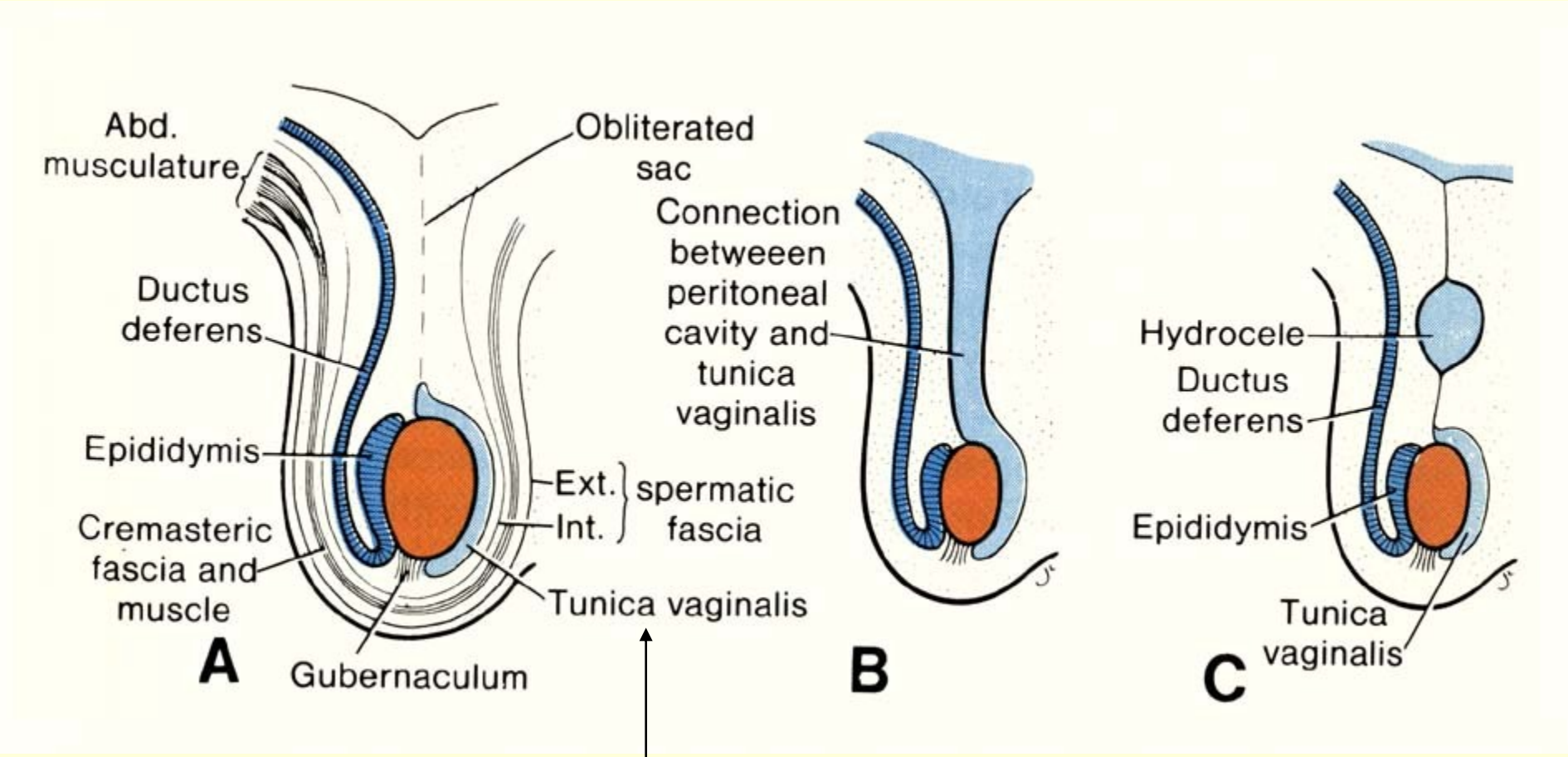
Congenital malformations – 2
defects of growth, position or cleft
local manifestation

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

Relocation of testes (descensus)



Hydrocele testis



Peritoneal duplicature

Obstruction in way of descensus

CRYPTORCHID ← → ECTOPIC

Defect insertion of gubernaculum

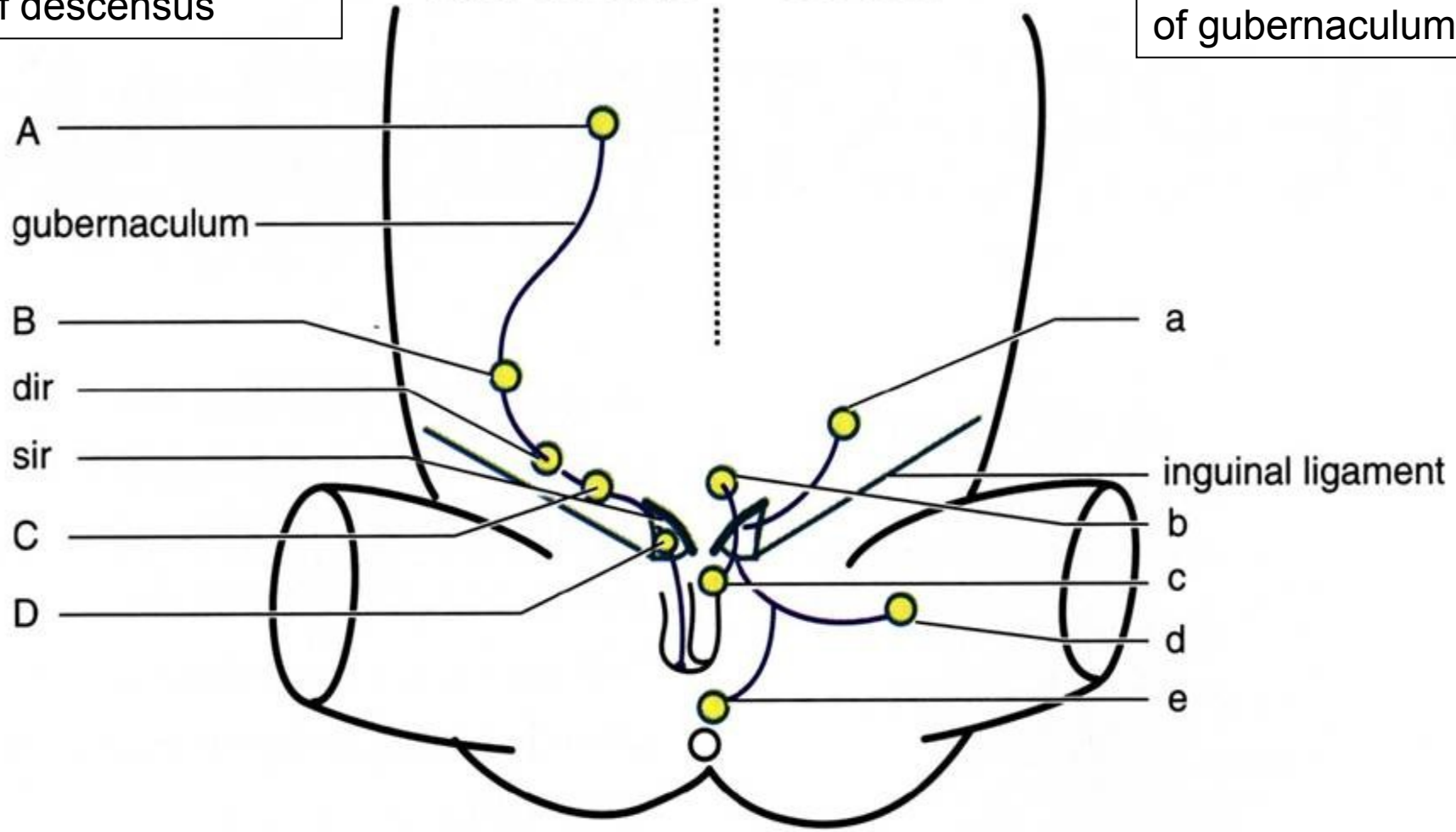


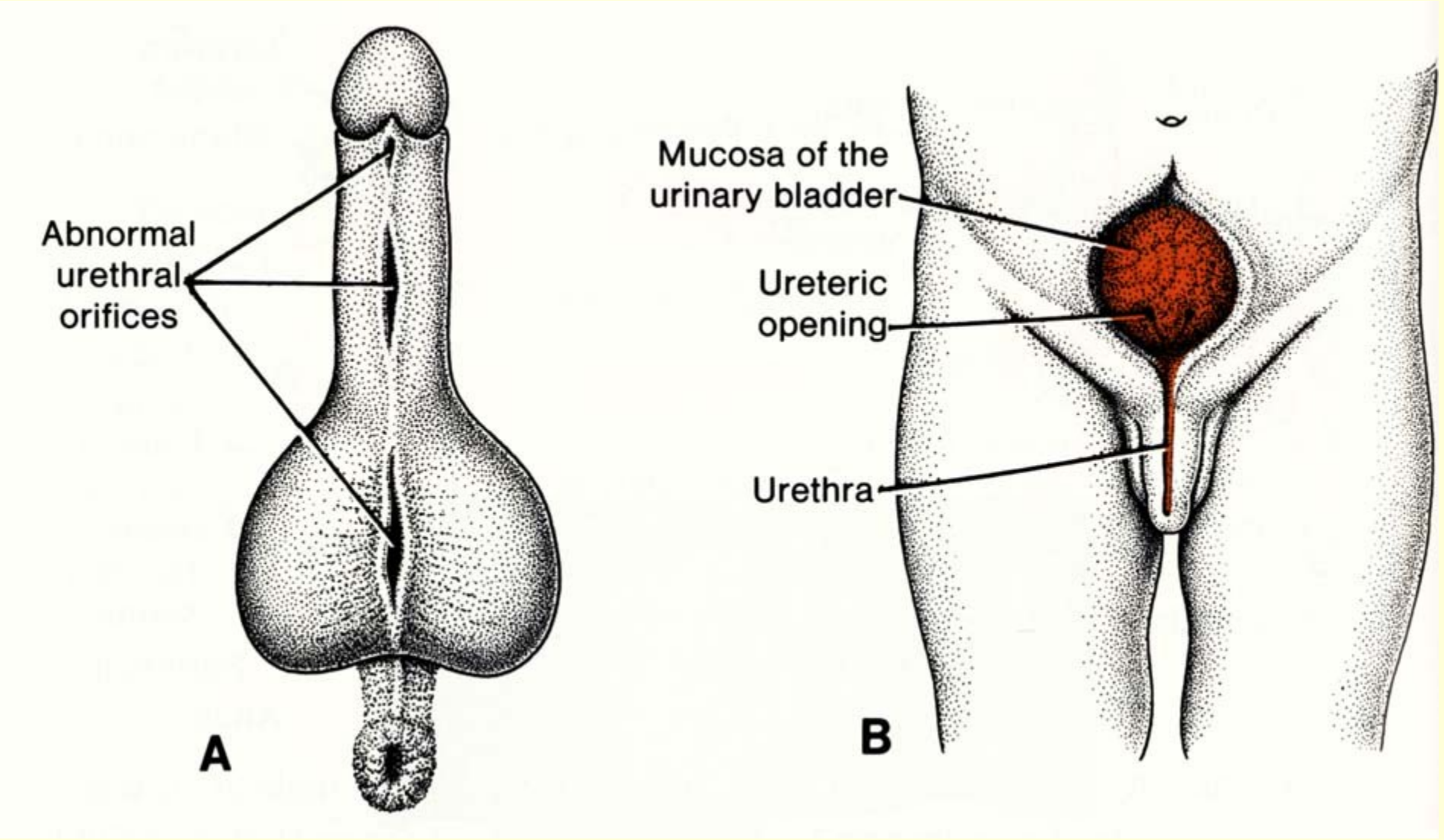
FIGURE 3 Abnormal descent of the testis. On the left, cryptorchid sites of arrest are shown: **A**, abdominal; **B**, pelvic; **C**, inguinal; **D**, at the superficial inguinal ring. **dir**, **sir**, deep and superficial inguinal rings. On the right, ectopic sites are shown: **a**, supra-inguinal;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

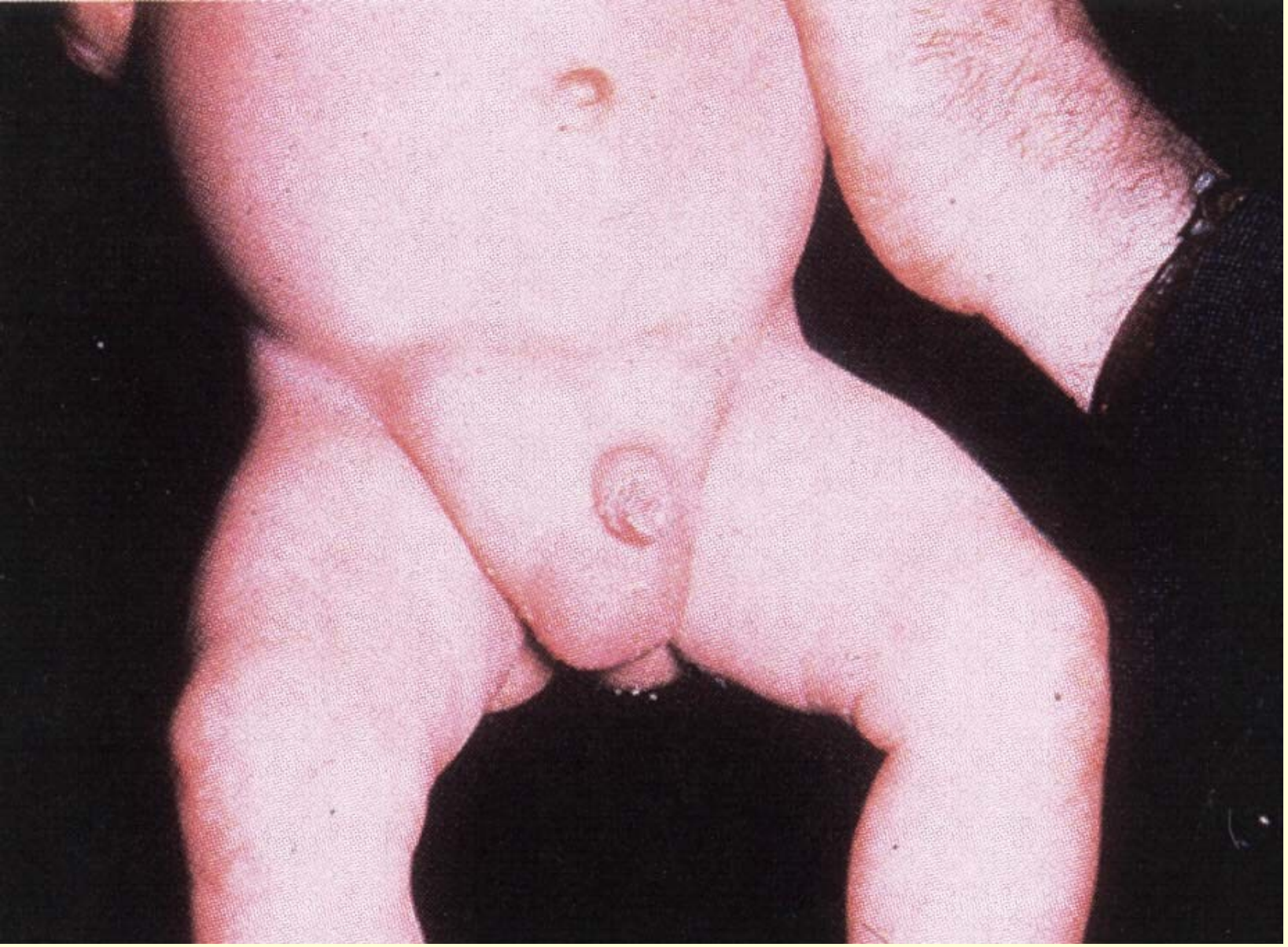
Kryptorchidism

HYPOSPADIAS

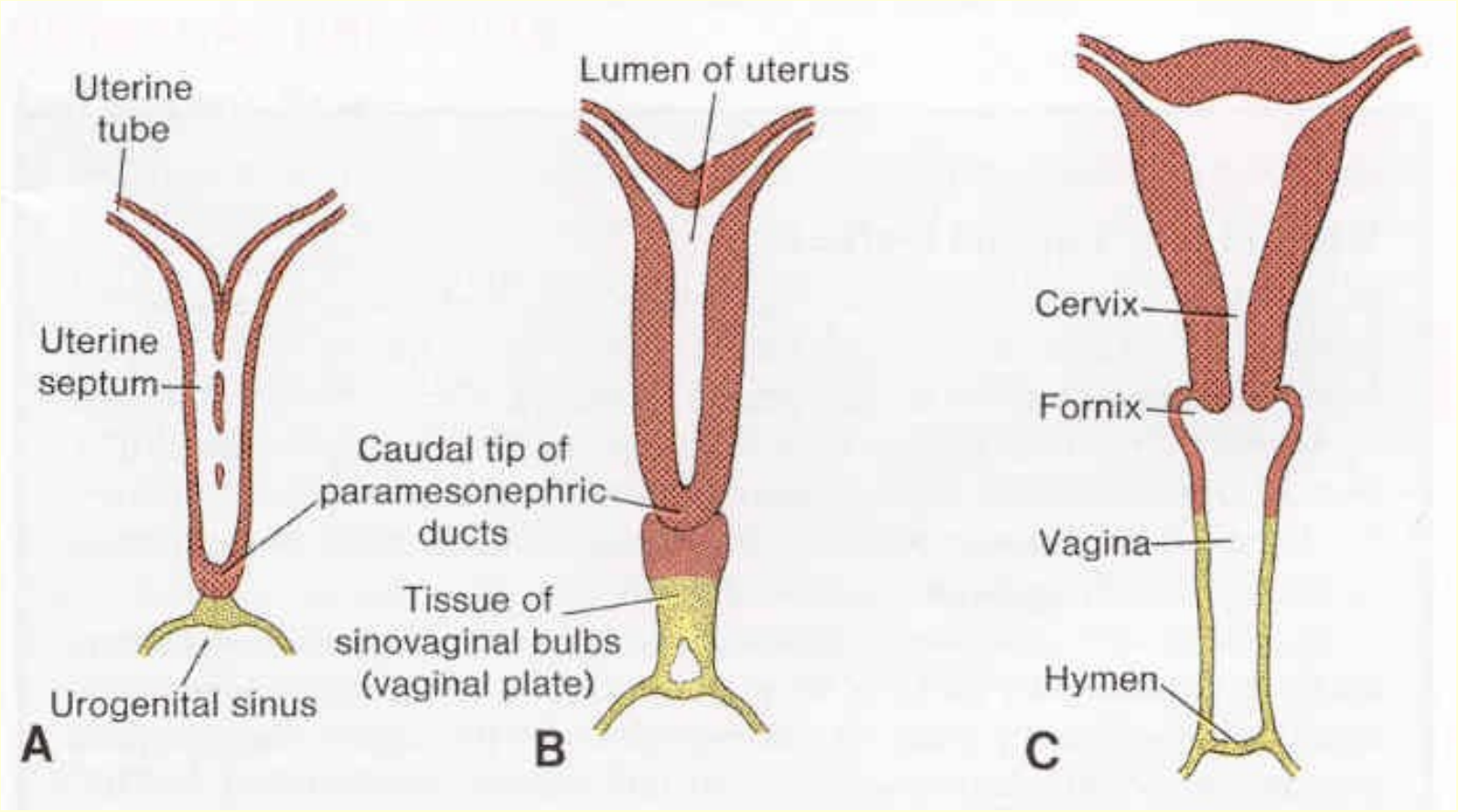
EPISPADIAS

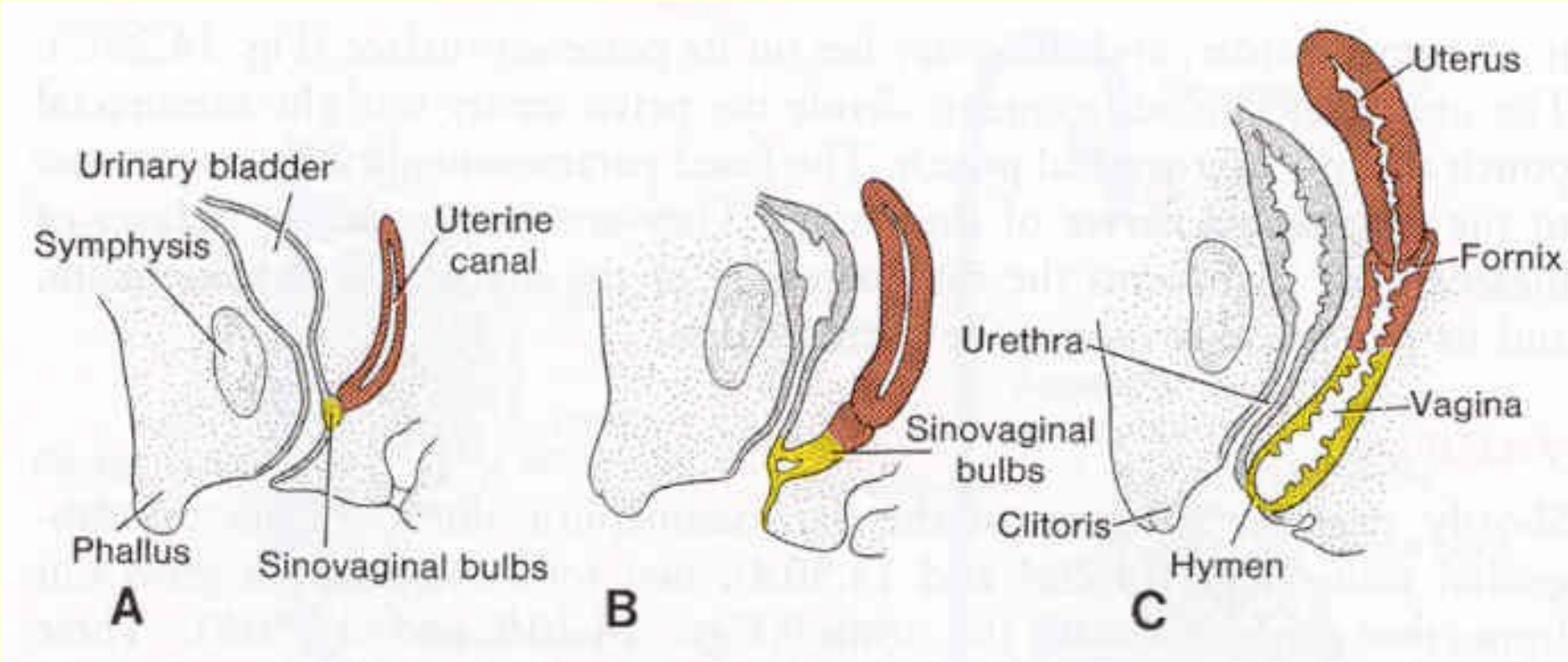
+ extrophia vesicae urinariae

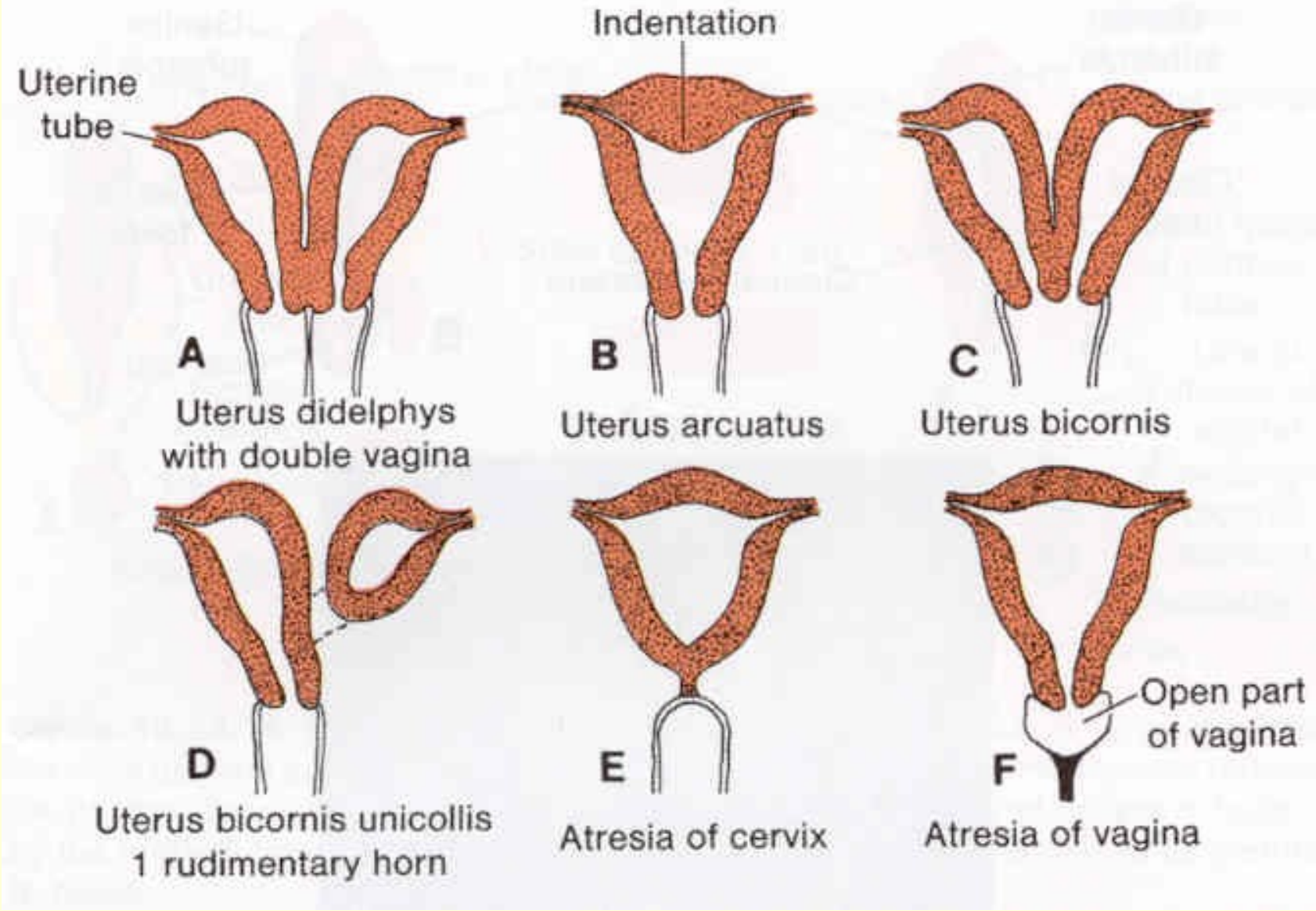




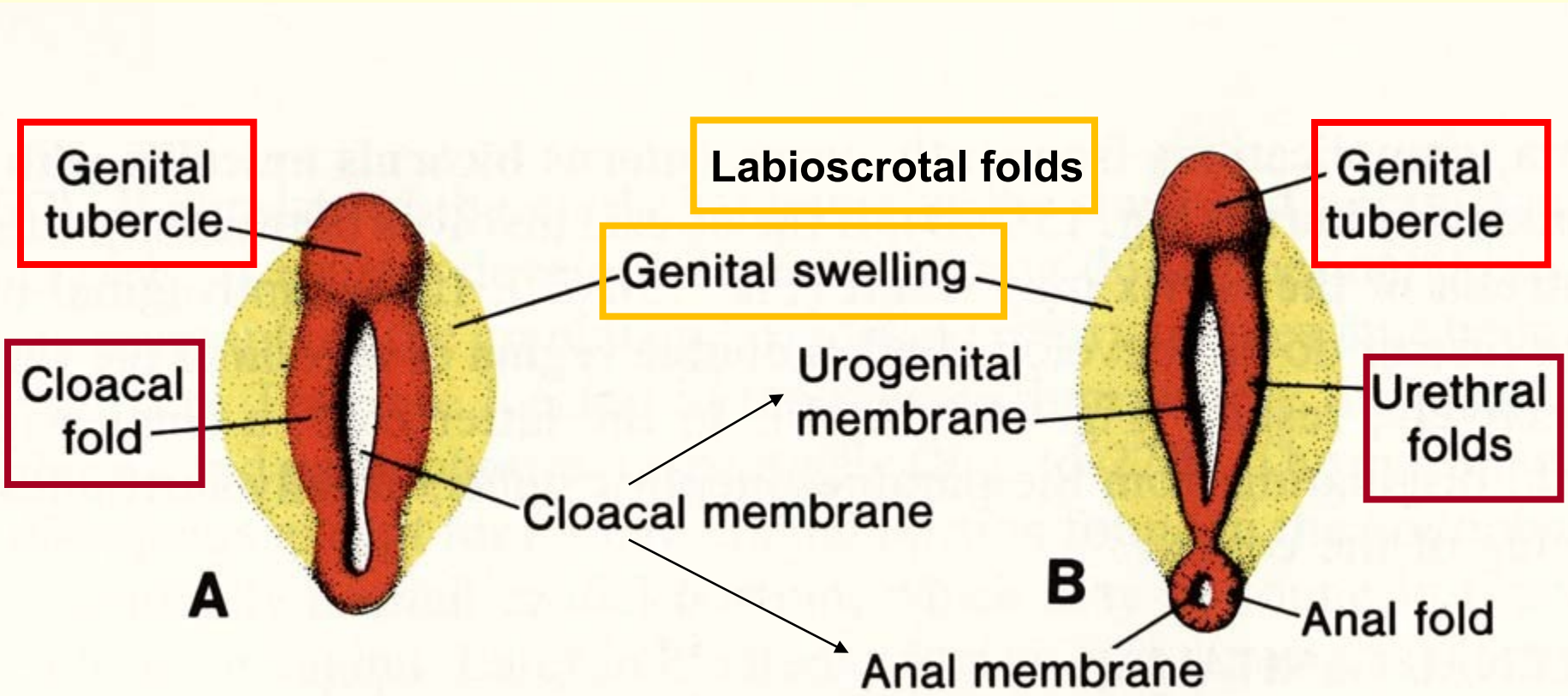
Congnital bilateral inguinal hernia


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

Thank for your attention


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