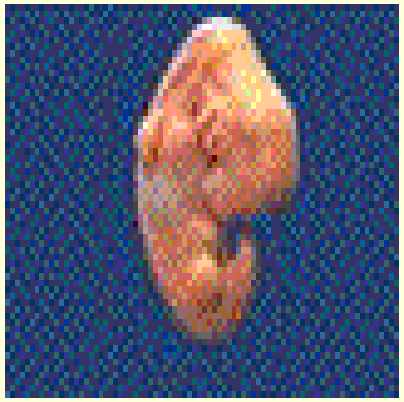


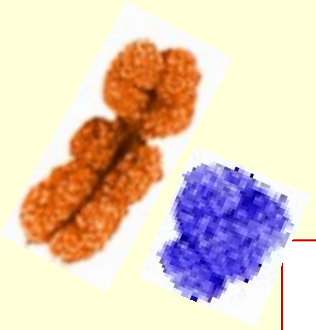
Embryology /organogenesis/

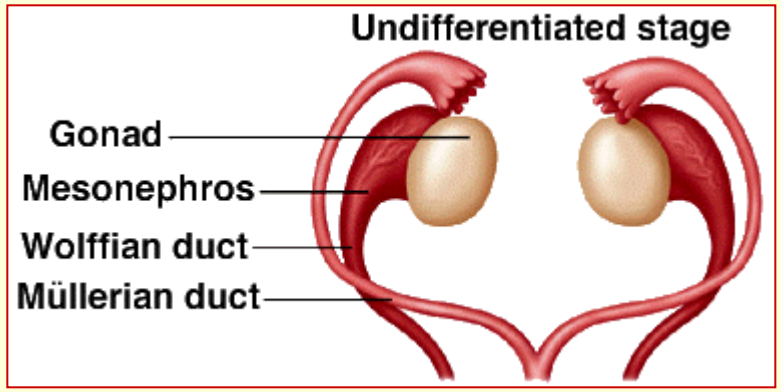
Week 4: 06. 04 – 10. 04. 2009

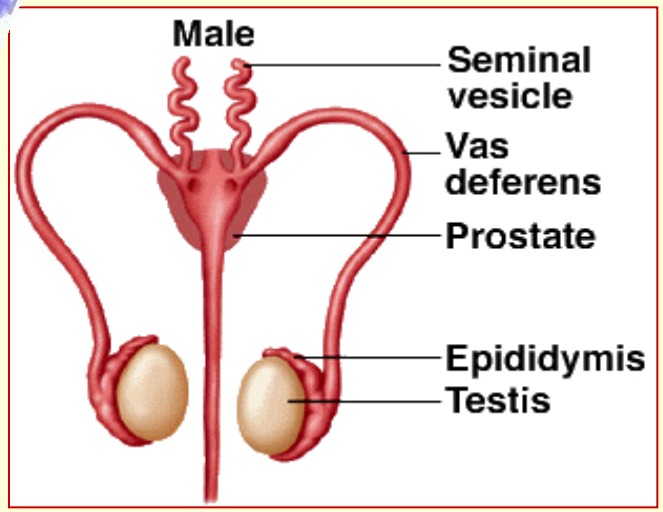
Development and teratology of reproductive system.
Repetition: blood and hematopoiesis.

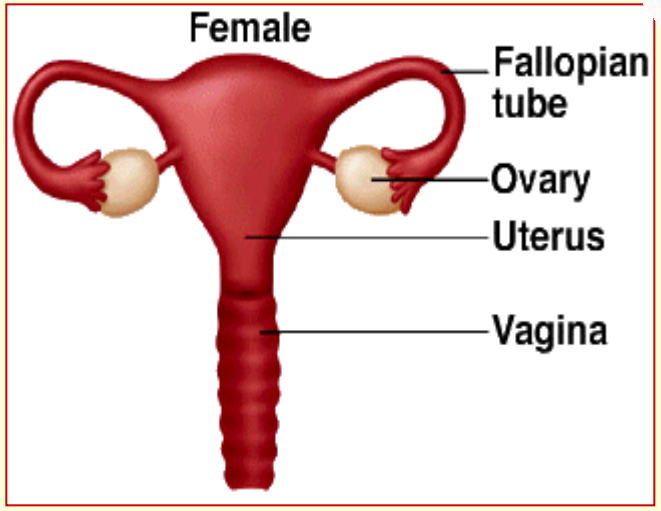
19. Indifferent stage in development of reproductive system.
20. Development of male and female gonad.
21. An overview of development of male and female genital duct.
22. Development of external genital organs.
23. Developmental malformations of urogenital system.

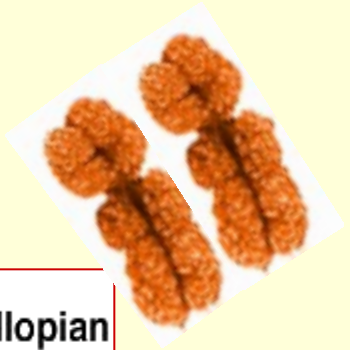
Male or female sex is determined by spermatozoon Y in the moment of fertilization





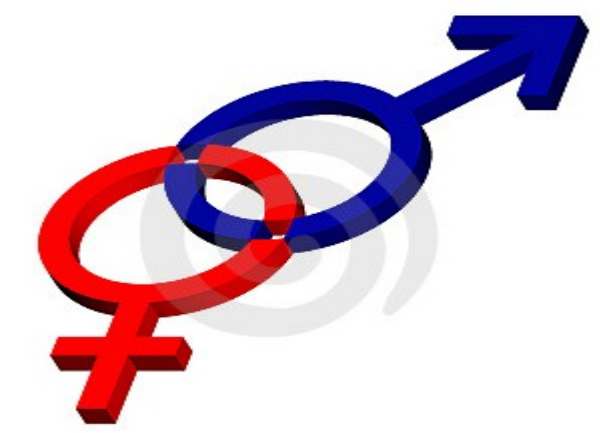






SRY gene, on the short arm of the Y chromosome, initiates male sexual differentiation.

- The SRY influences the undifferentiated gonad to form testes, which produce the hormones supporting development of male reproductive organs.
- Developed testes produce testosterone (T) and anti-Mullerian hormone (AMH).
- Testosterone stimulates the Wolffian ducts development (epididymis and deferent ducts).
- AMH suppresses the Mullerian ducts development (fallopian tubes, uterus, and upper vagina).

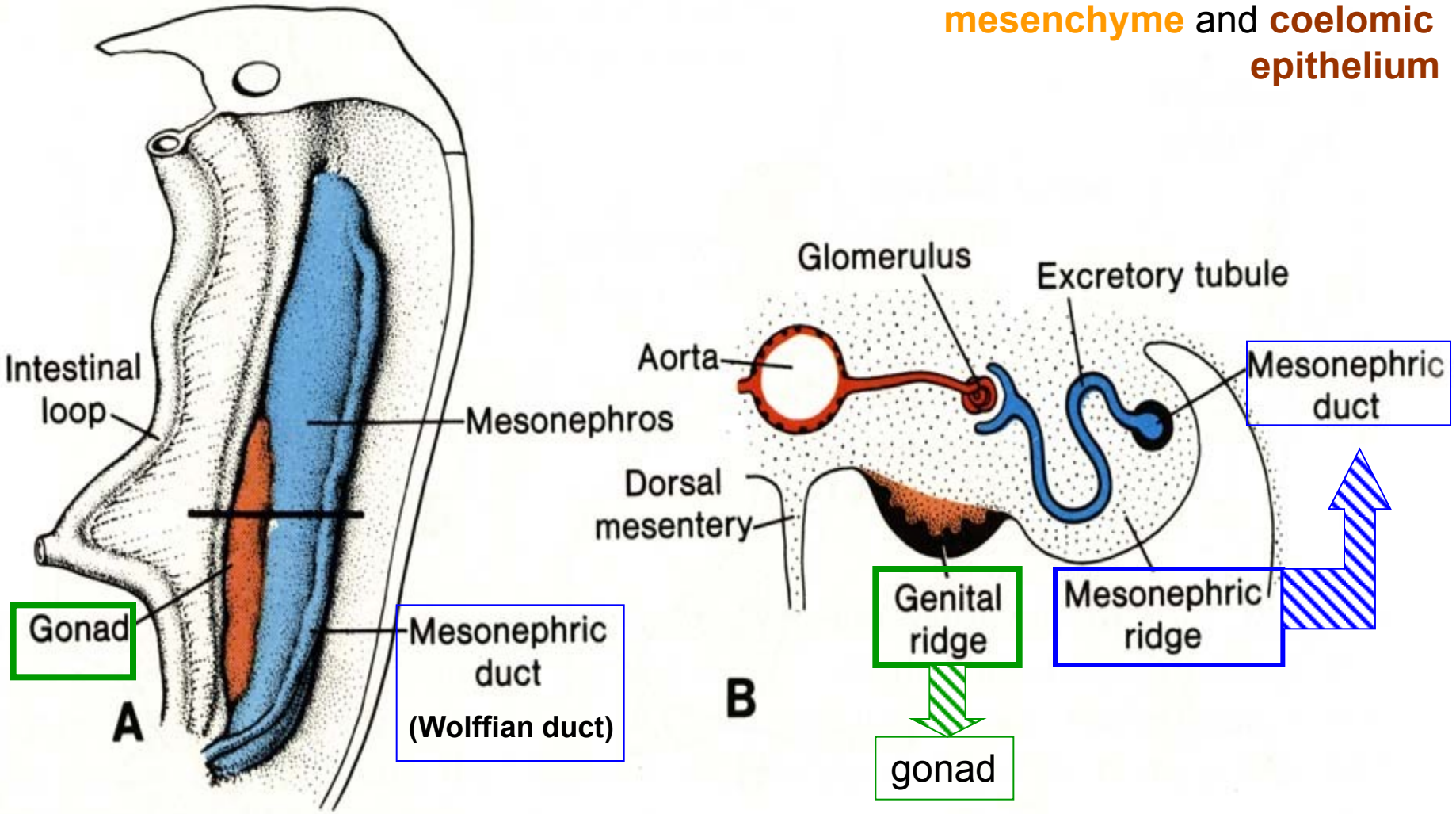


- Indifferent stage – until the 7th week
- Different stage

- Development of gonads
- Development of reproductive passages
- 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**

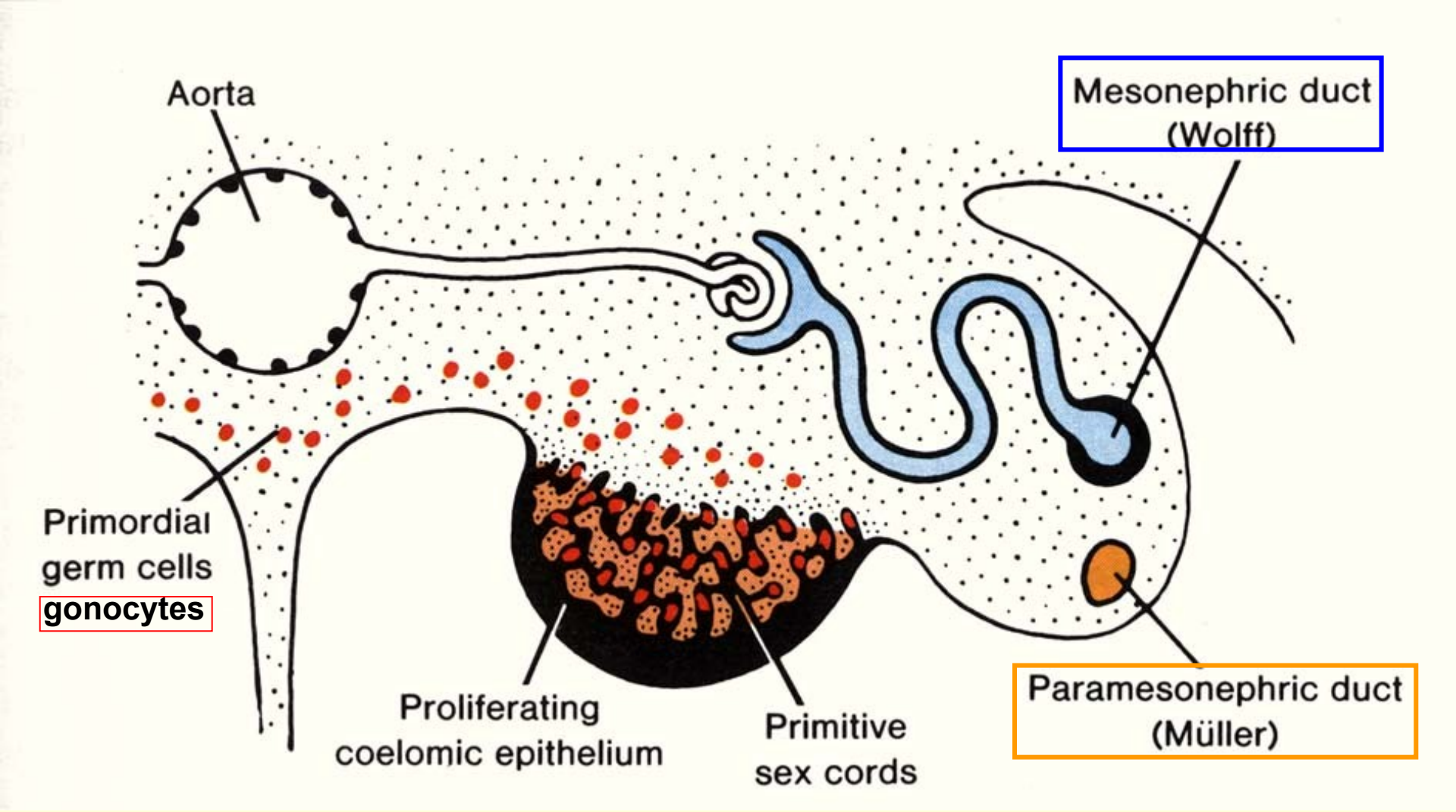


Three sources of gonad development:

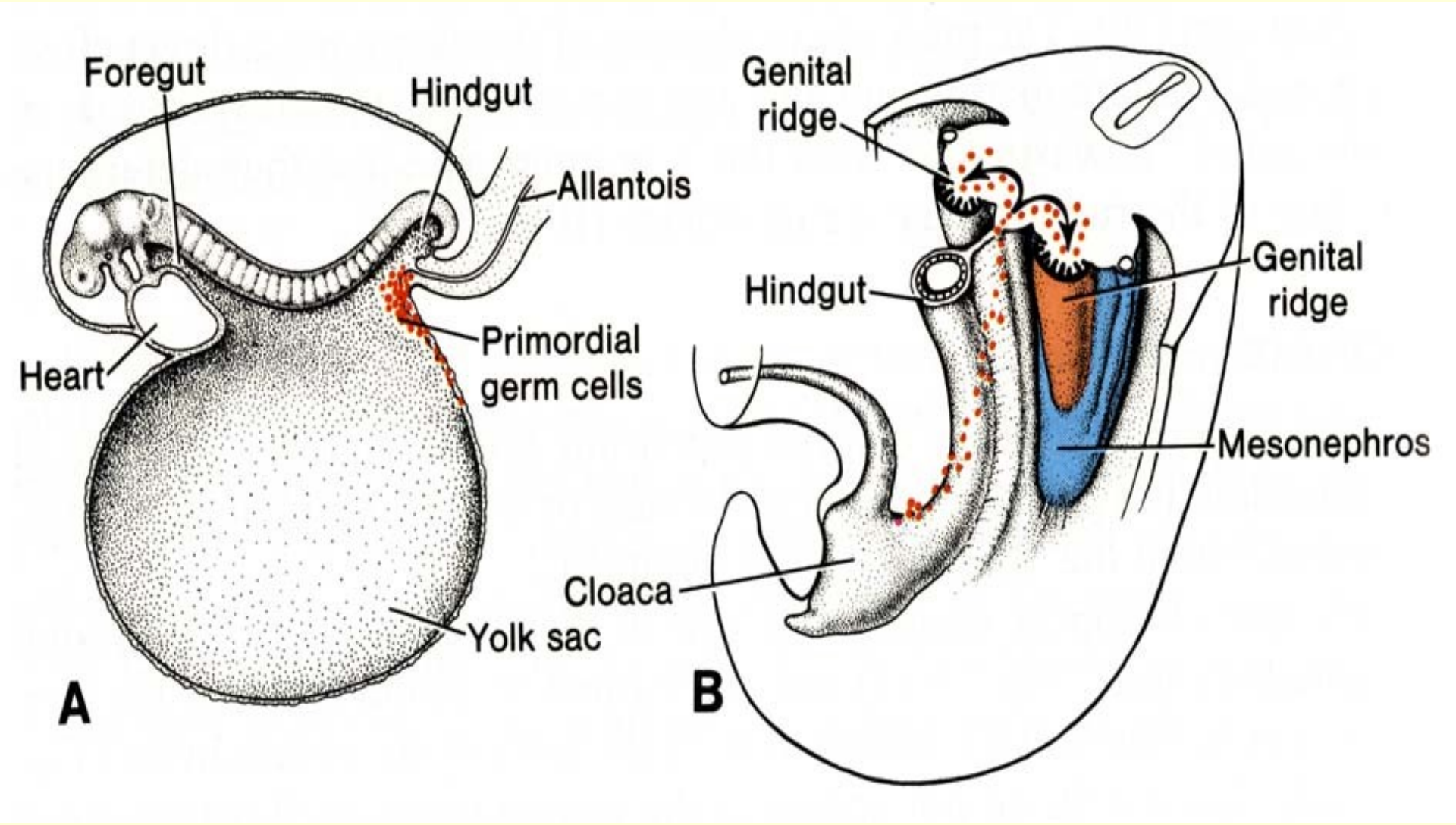
1 – condensed mesenchyme of gonadal ridges (plica genitalis)

2 – coelomic epithelium (mesodermal origin)

3 – gonocytes (primordial cells)

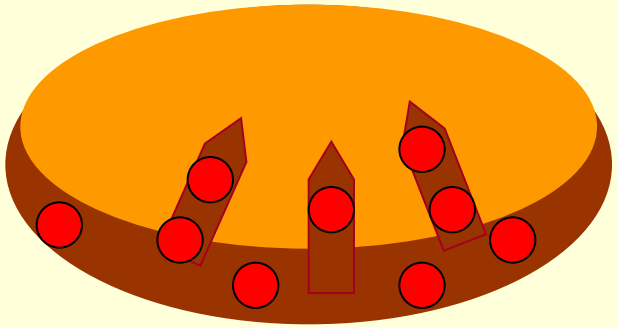


Primordial germ cells – gonocytes – appeare among endoderm in dorsal wall of yolk sac. Gonocyte migrate along dorsal mesentery of hindgut into the gonadal ridges and induce (!) gonad development.



Indifferent gonad development

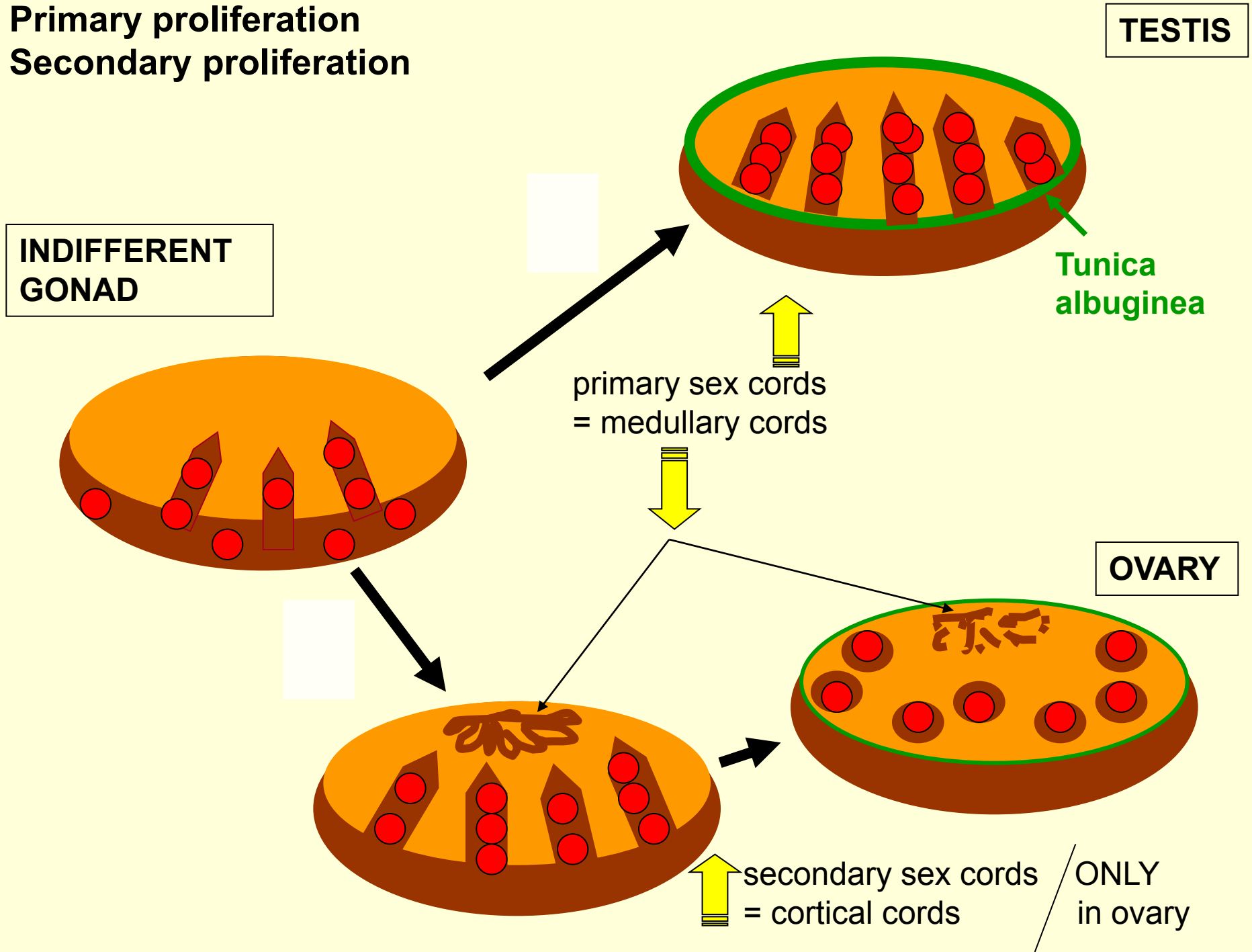
- Gonocytes penetrate coelomic epithelium and mesenchyme



Together with **gonocytes**, also **cells of coelomic epithelium** penetrate **mesenchyma**:

primary (primitive) **sex cords**

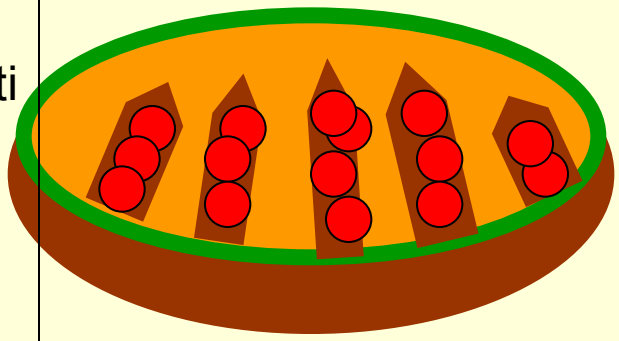
of indifferent gonad


Primary proliferation
Secondary proliferation
TESTIS
INDIFFERENT GONAD
Tunica albuginea
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

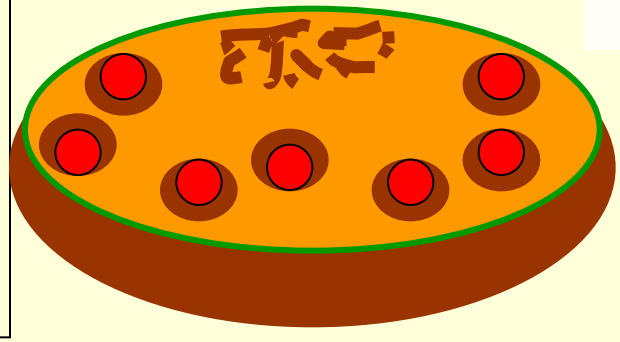


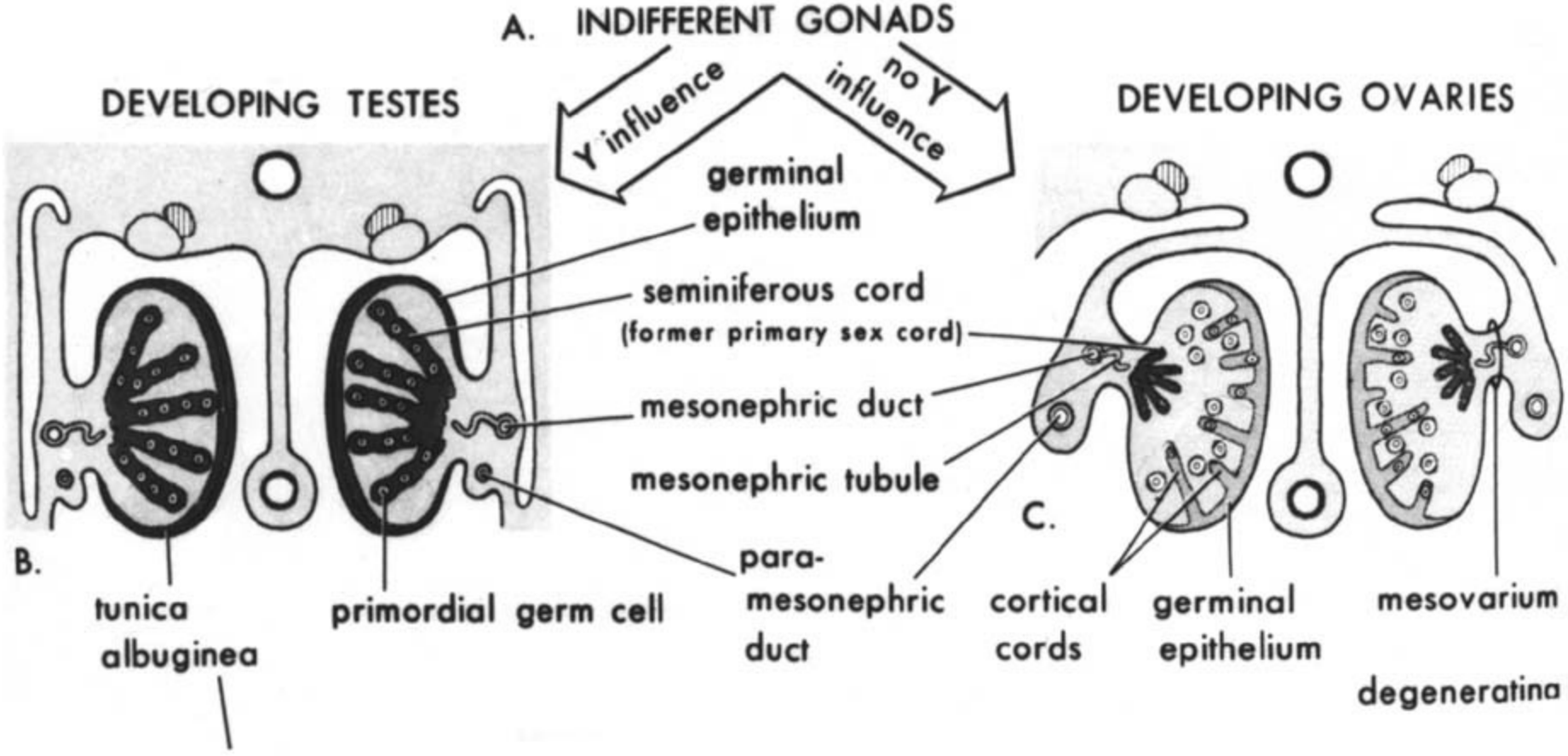
Tunica albuginea

OVARY:

Primary sex cords ⇨ degenerate in ovarian medulla

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



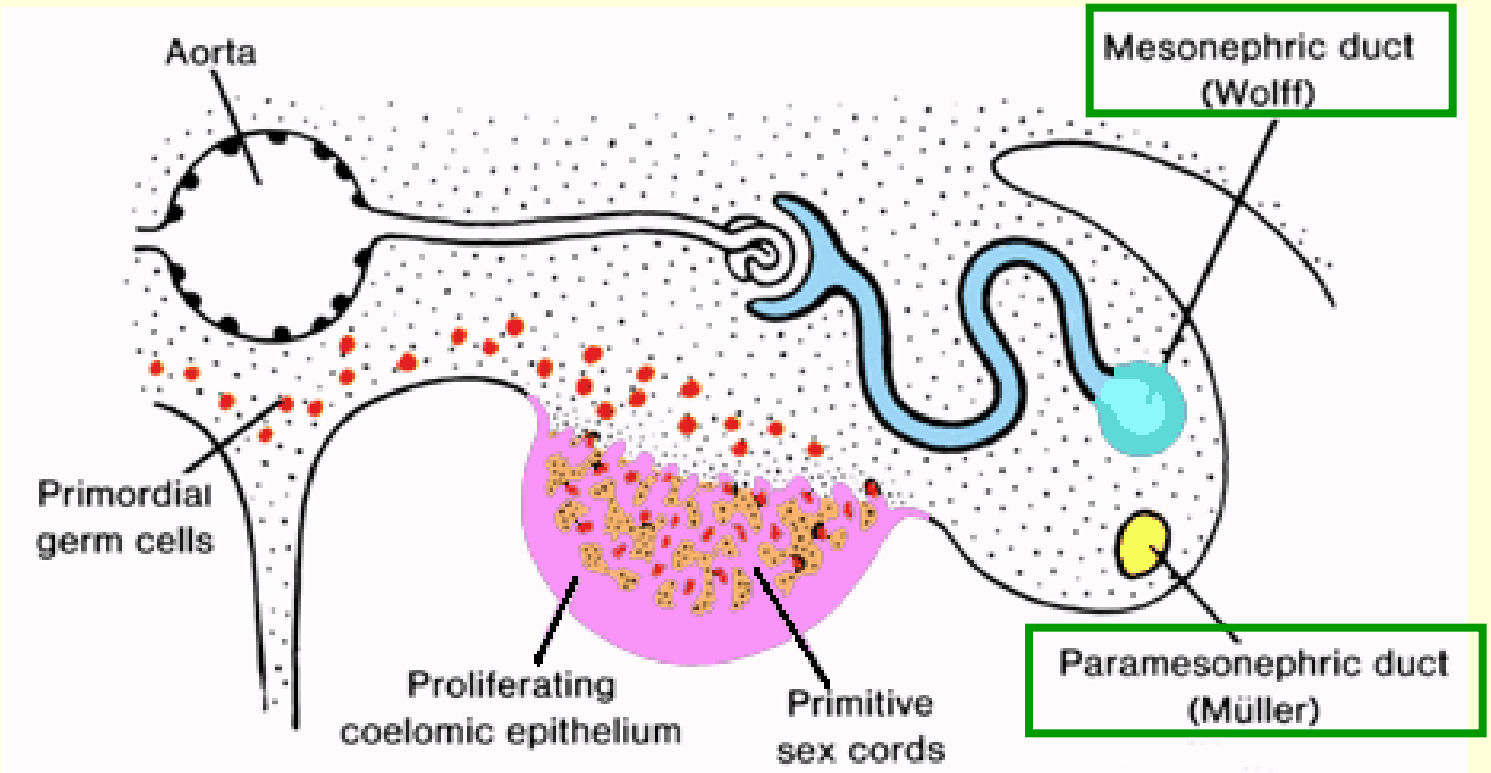

A. INDIFFERENT GONADS
Y influence
no Y influence
DEVELOPING TESTES
DEVELOPING OVARIES
germinal epithelium
seminiferous cord
(former primary sex cord)
mesonephric duct
mesonephric tubule
B.
C.
tunica albuginea
primordial germ cell
para-mesonephric duct
cortical cords
germinal epithelium
mesovarium
degeneratina

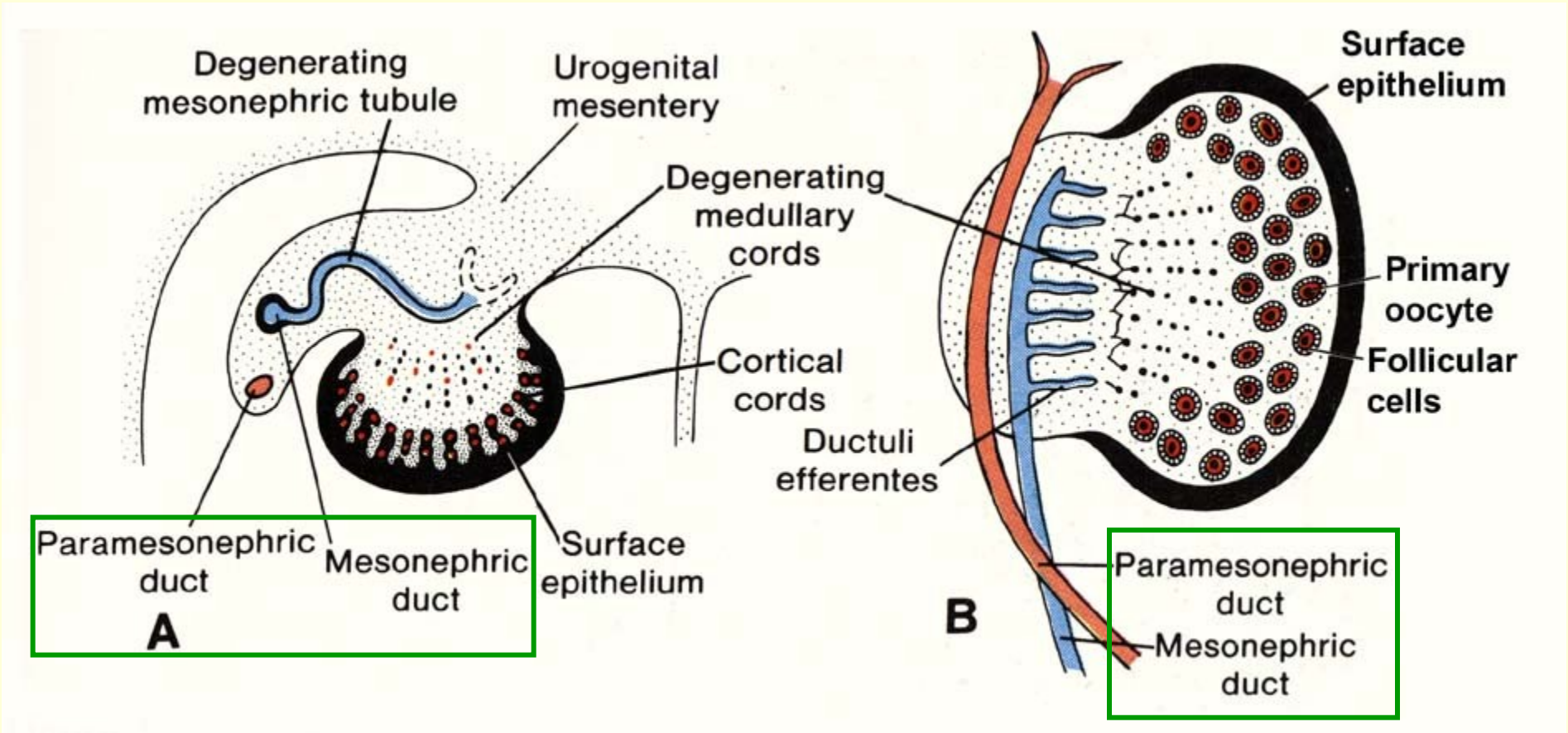
Development of reproductive passages
(indifferent – differentiated stage)

- Plica urogenitalis (urogenital ridge) – 2 ducts:

Ductus mesonephricus (Wolffi)

Ductus paramesonephricus (Mülleri)

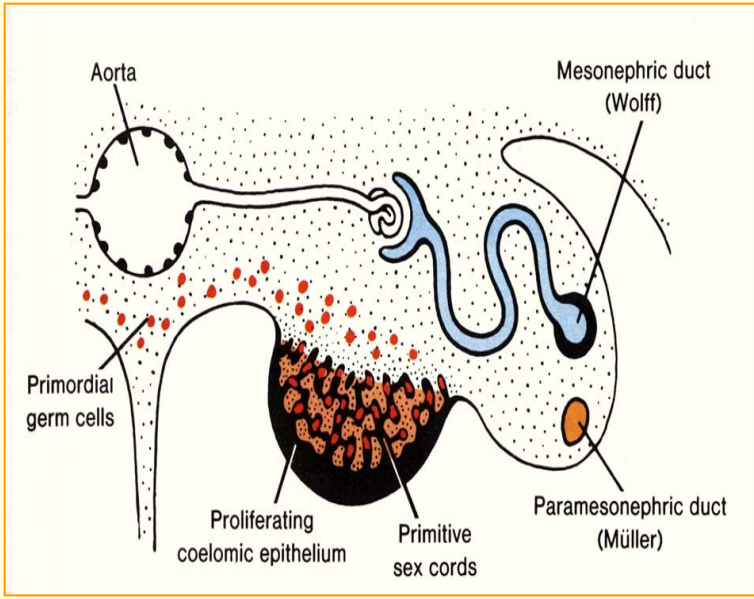



Degenerating mesonephric tubule
Urogenital mesentery
Degenerating medullary cords
Cortical cords
Paramesonephric duct
Mesonephric duct
Surface epithelium
A
Surface epithelium
Primary oocyte
Follicular cells
Ductuli efferentes
Paramesonephric duct
Mesonephric duct
B

Indifferent stage:

Wolffian duct

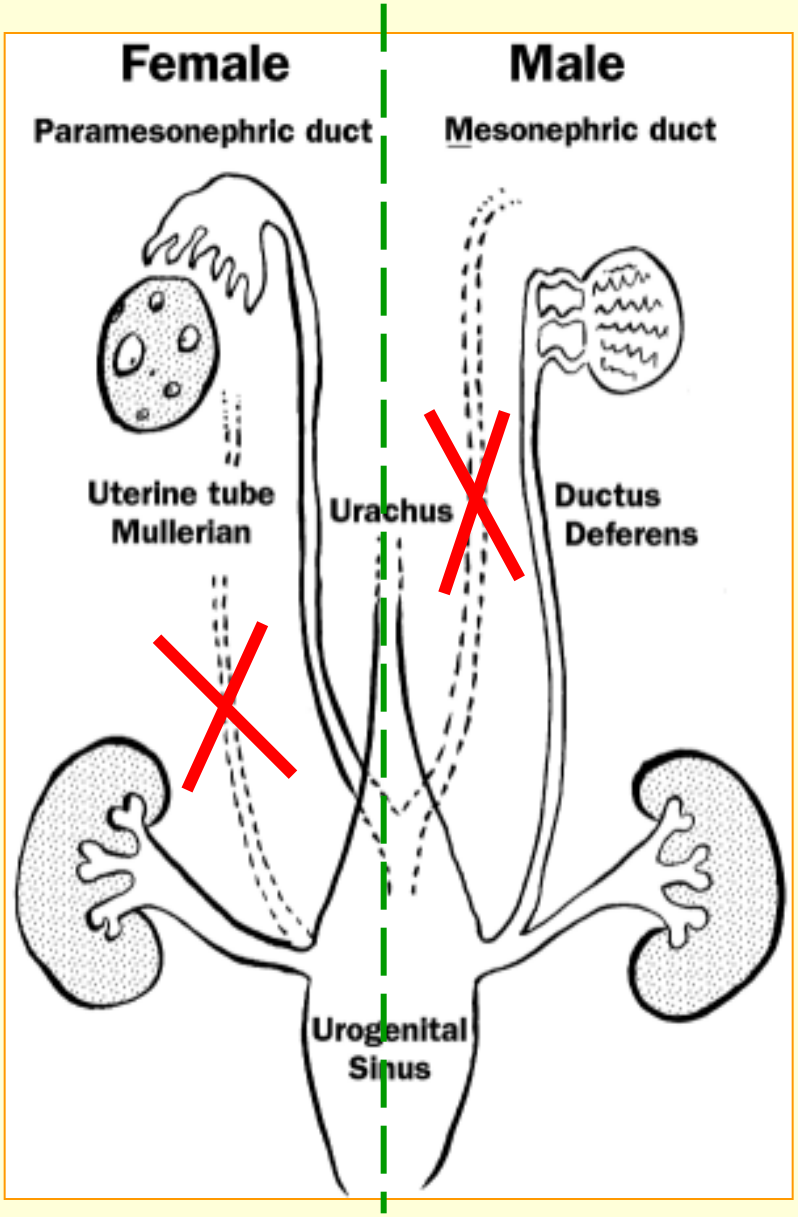
Müllerian duct



Differentiated stage of development:

Müllerian duct:

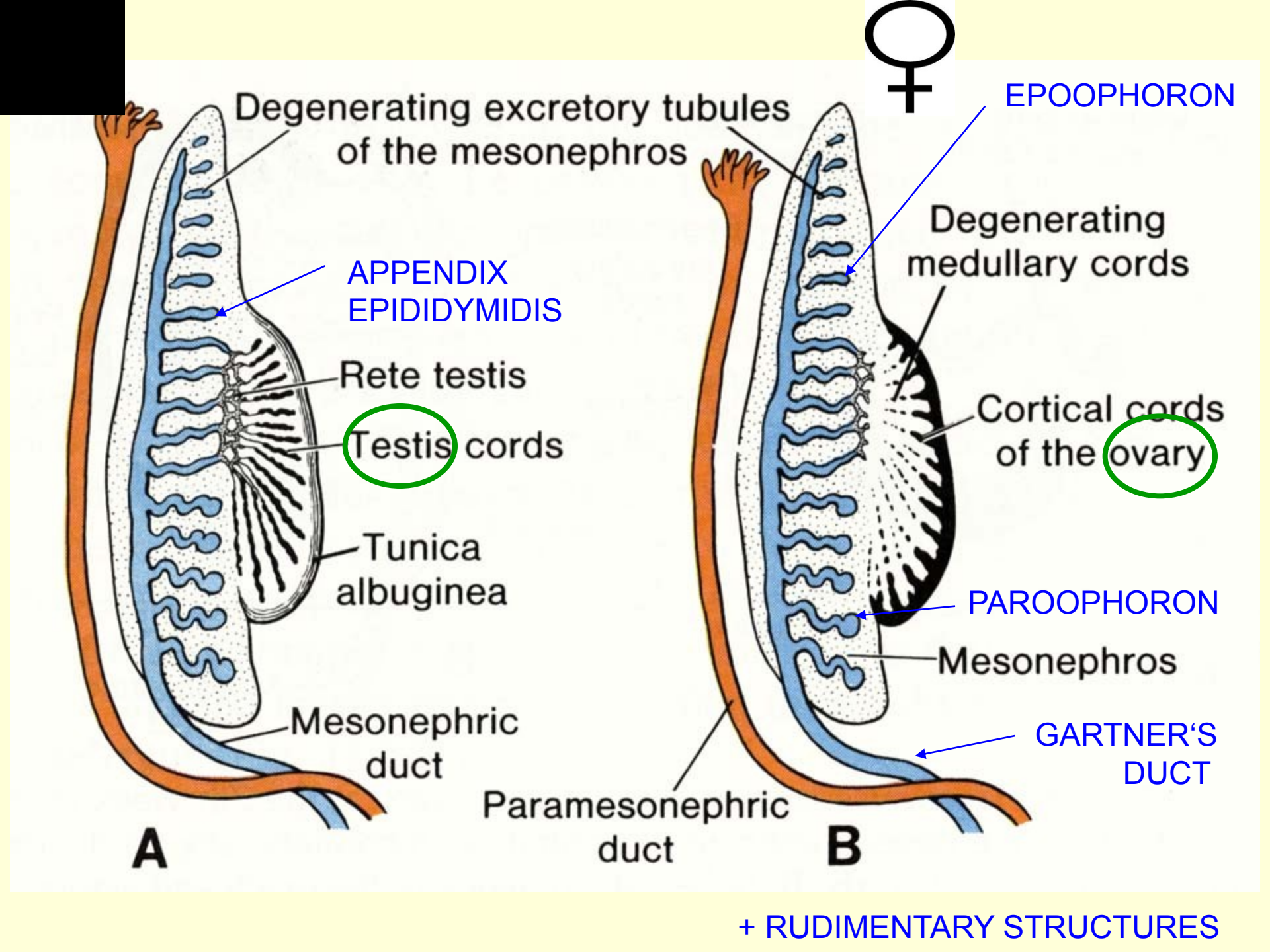
Oviduct
Uterus
Cranial part of vagina



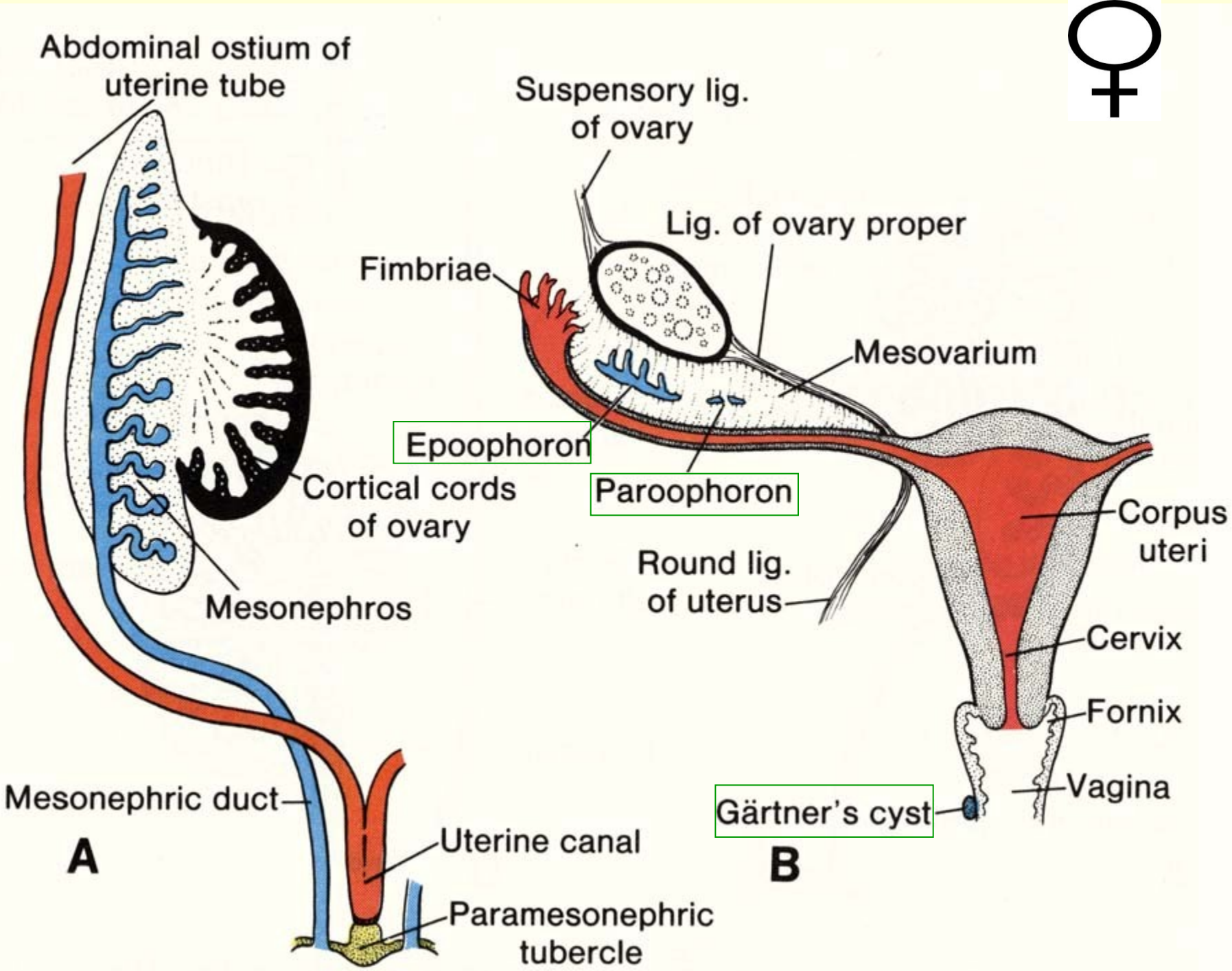
Wolffian duct:

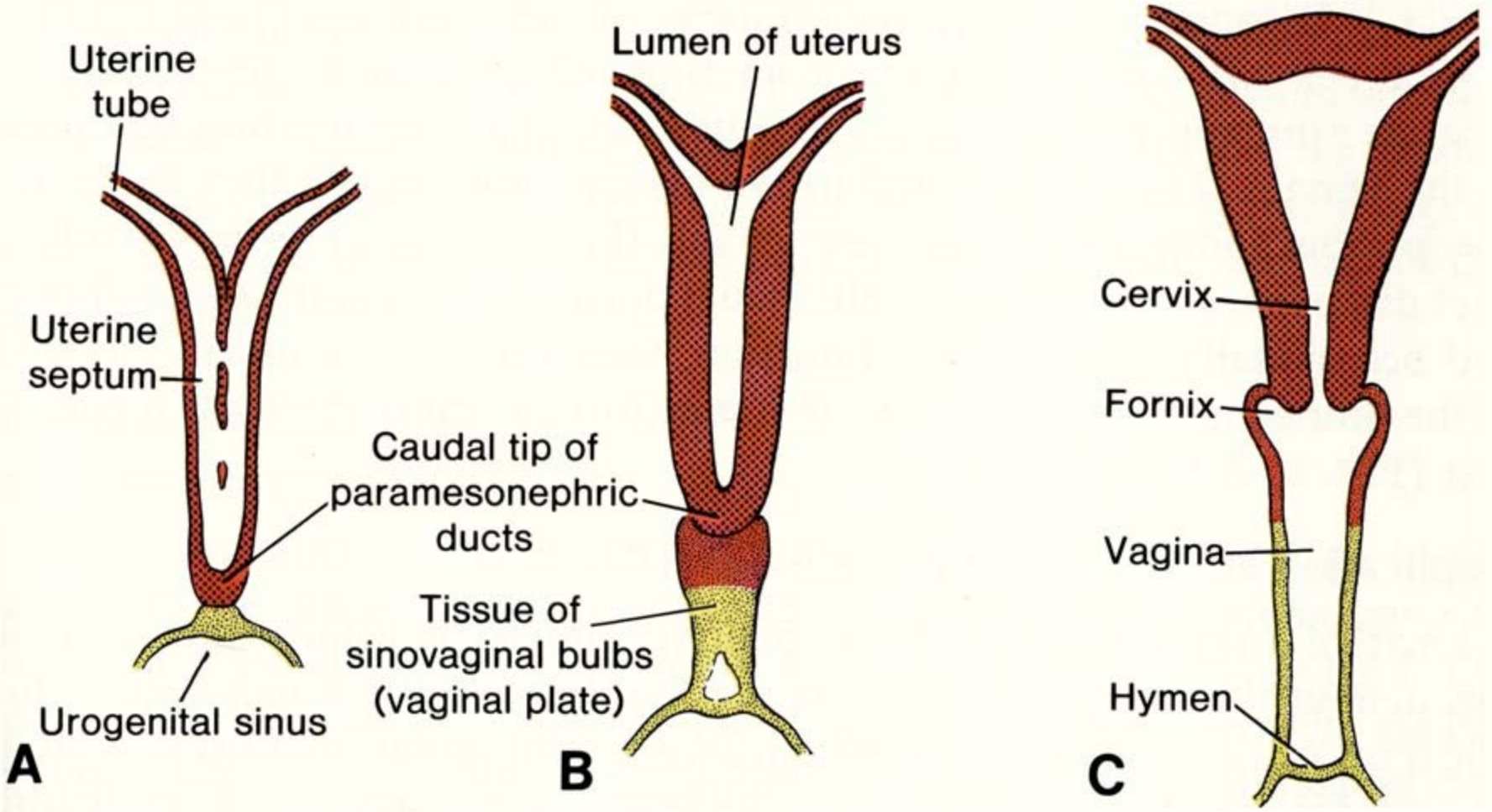
Ductus epididymidis
Ductus deferens
Ductus ejaculatorius

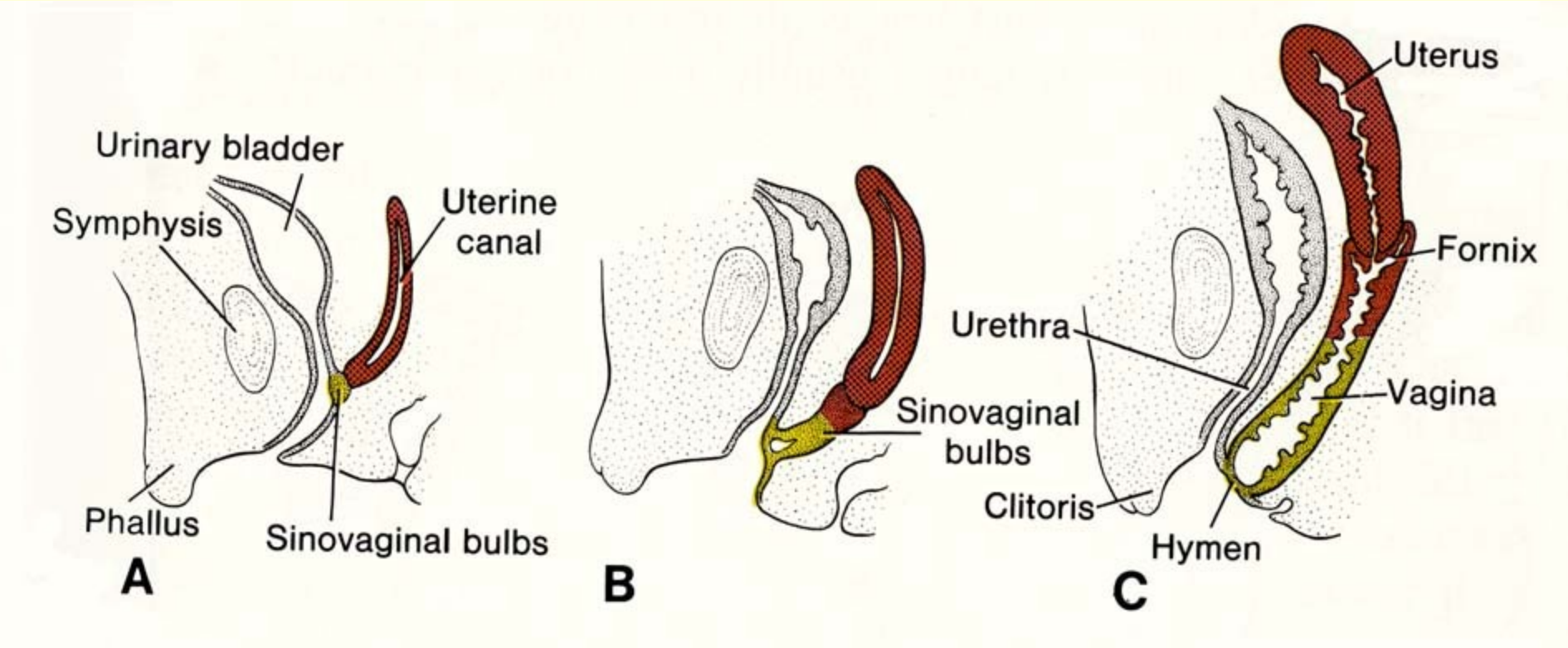
Ductuli efferentes in epididymis and rete testis originate from mesonephric tubules (see mesonephros)



+ RUDIMENTARY STRUCTURES


Abdominal ostium of uterine tube
Suspensory lig. of ovary
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


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

Development of external genatalia

(indifferent – differentiated stage)

Genital tubercle

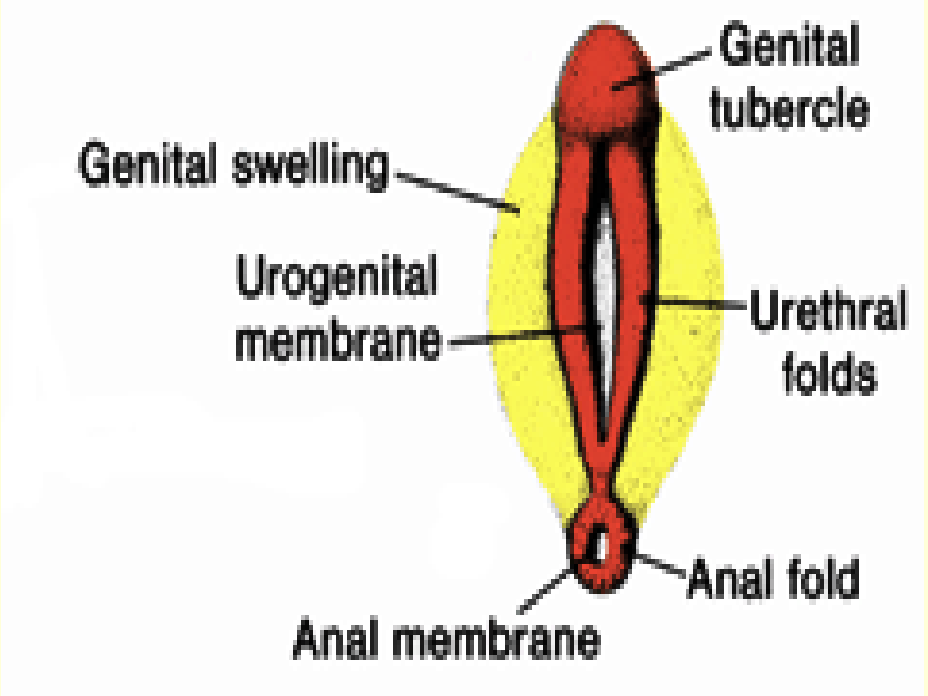
[tuberculum genitale]

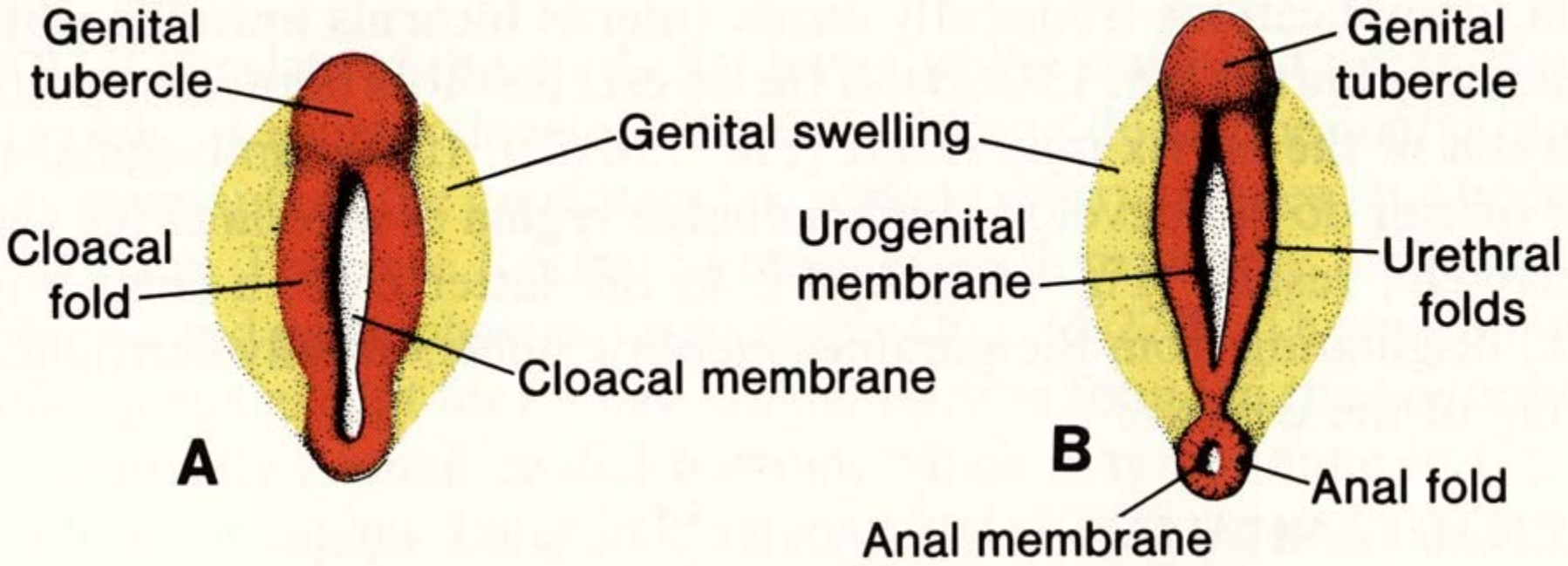
Urethral (cloacal) folds

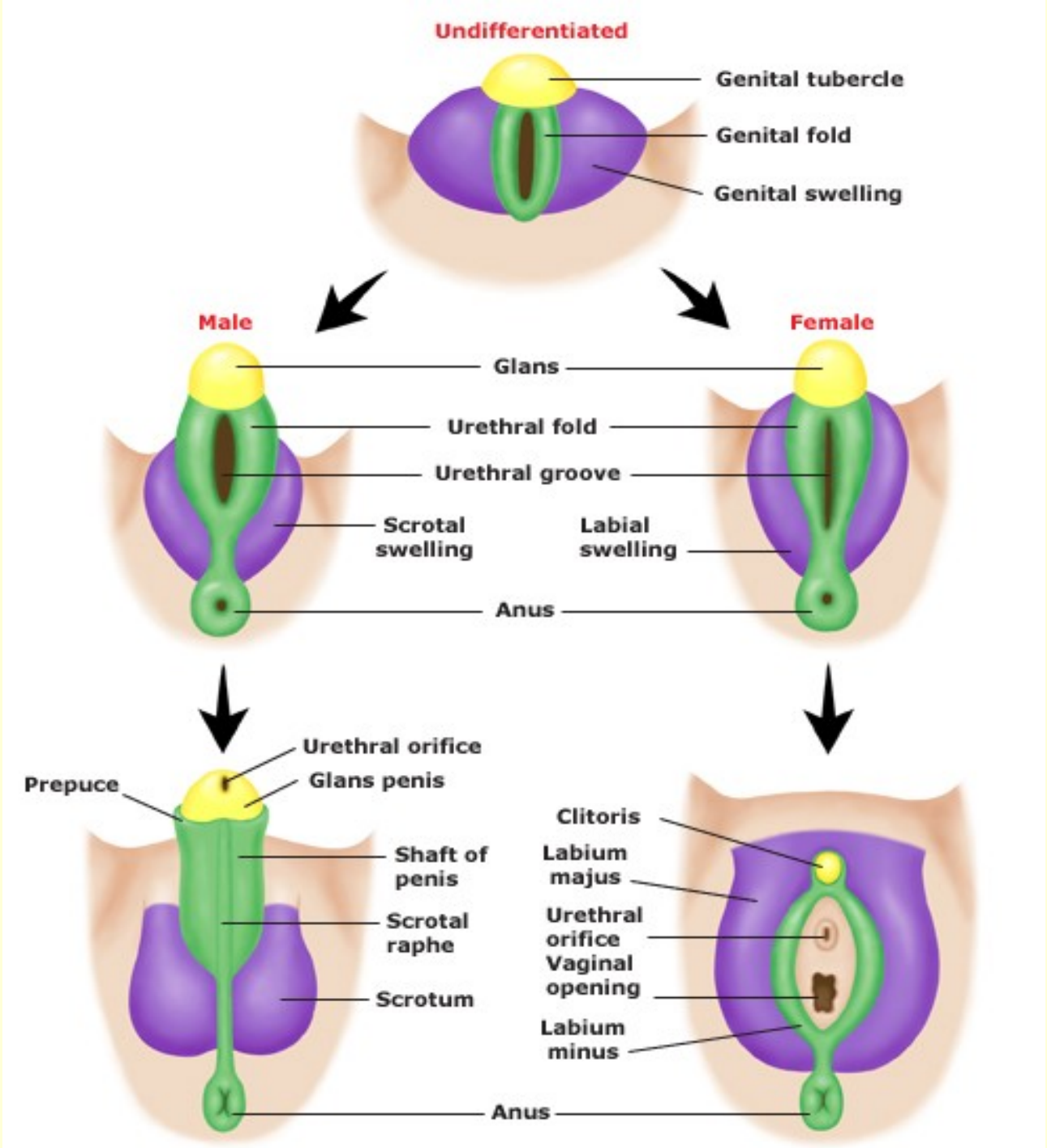
[plicae genitales]

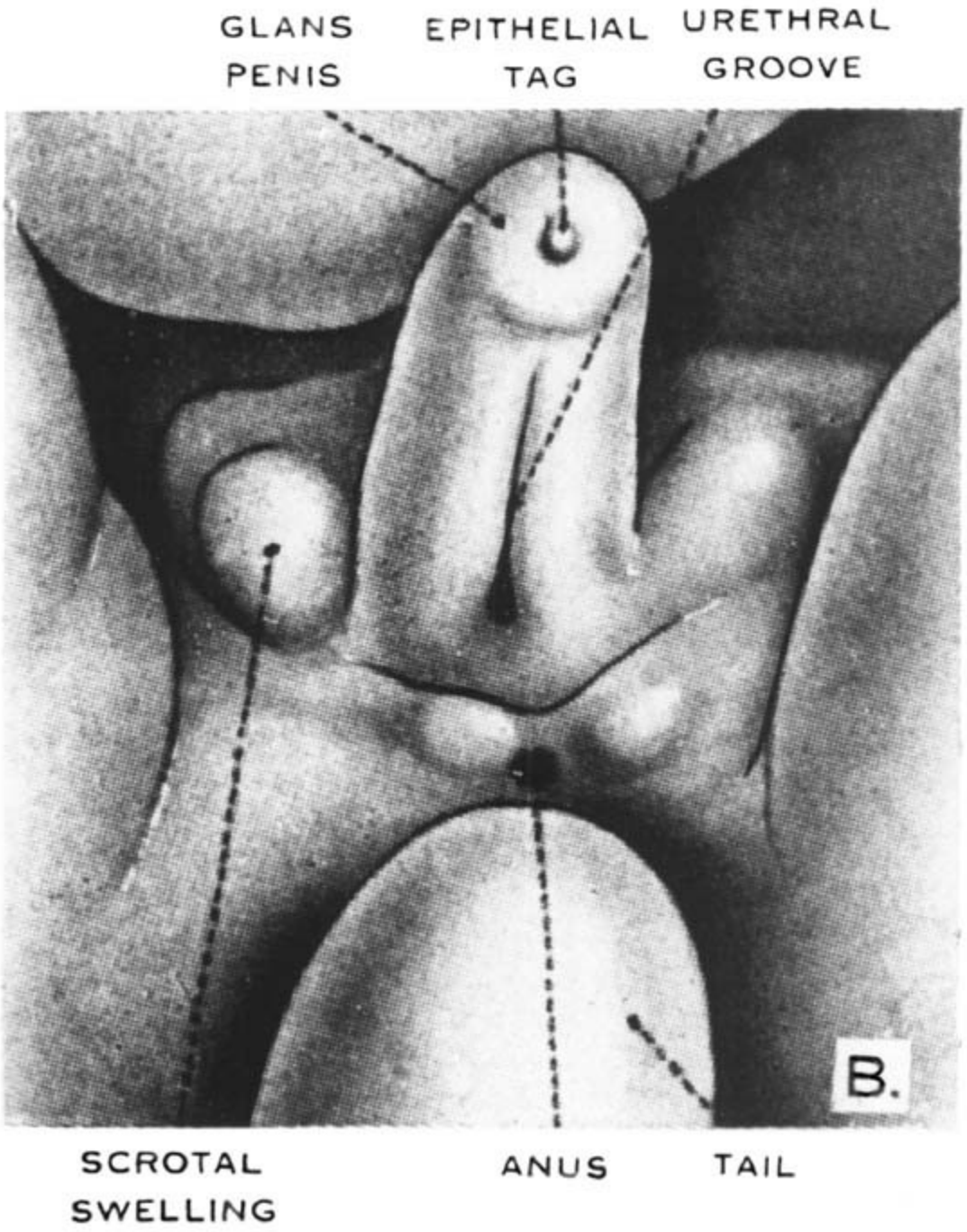
Labio-scrotal swellings

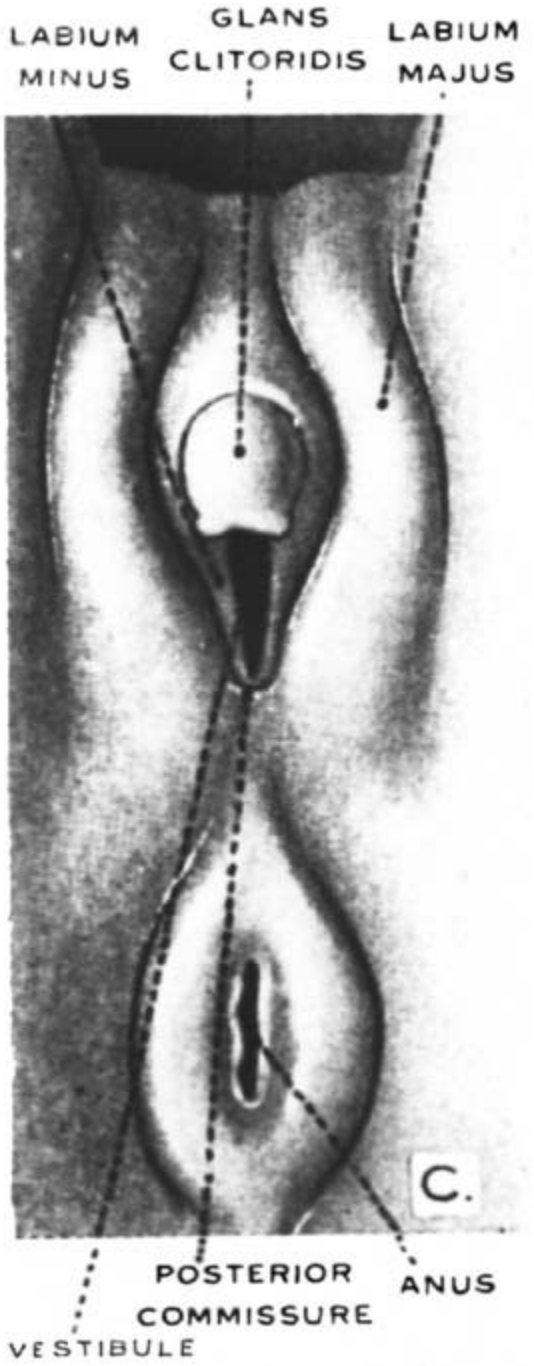
[tori genitales]



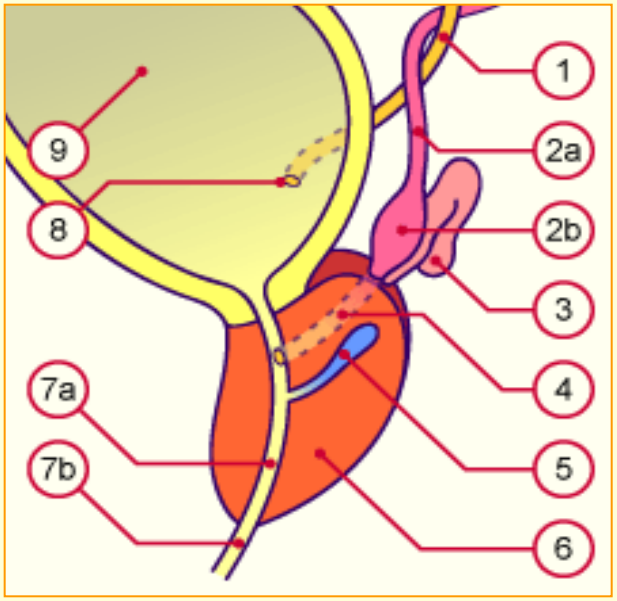

Genital tubercle
Genital swelling
Cloacal fold
Cloacal membrane
A
Genital tubercle
Urogenital membrane
Urethral folds
B
Anal fold
Anal membrane


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


GLANS PENIS
EPITHELIAL TAG
URETHRAL GROOVE
B.
SCROTAL SWELLING
ANUS
TAIL

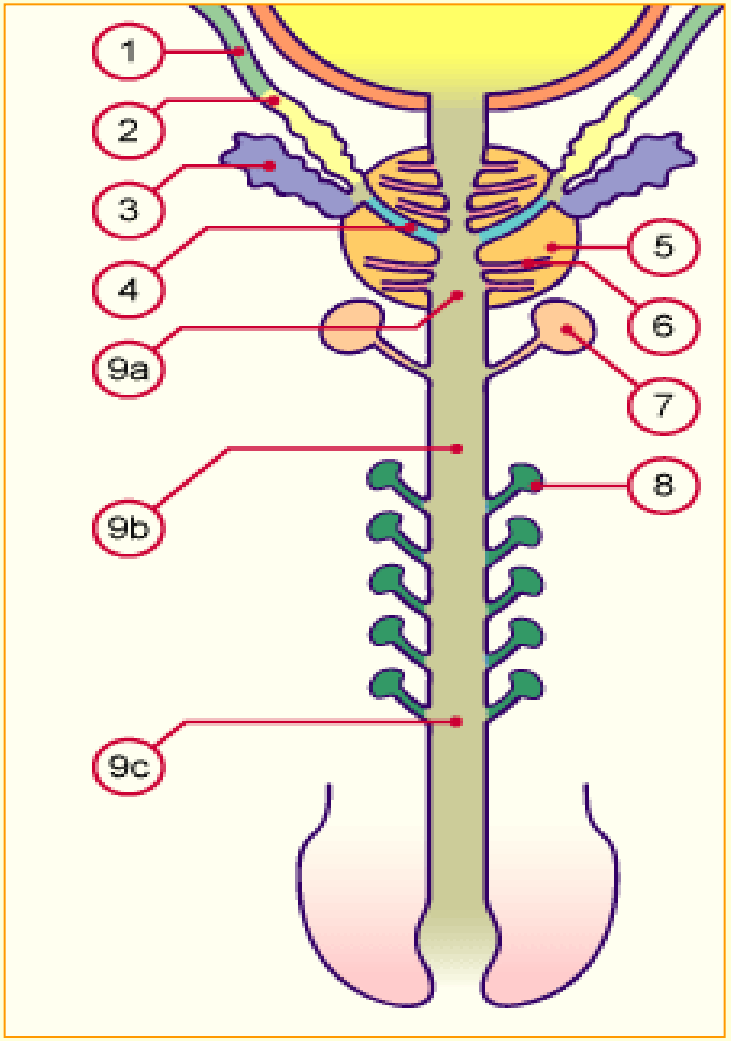

LABIUM MINUS
GLANS CLITORIDIS
LABIUM MAJUS
C.
POSTERIOR COMMISSURE
ANUS
VESTIBULE

Accessory glands development



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

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

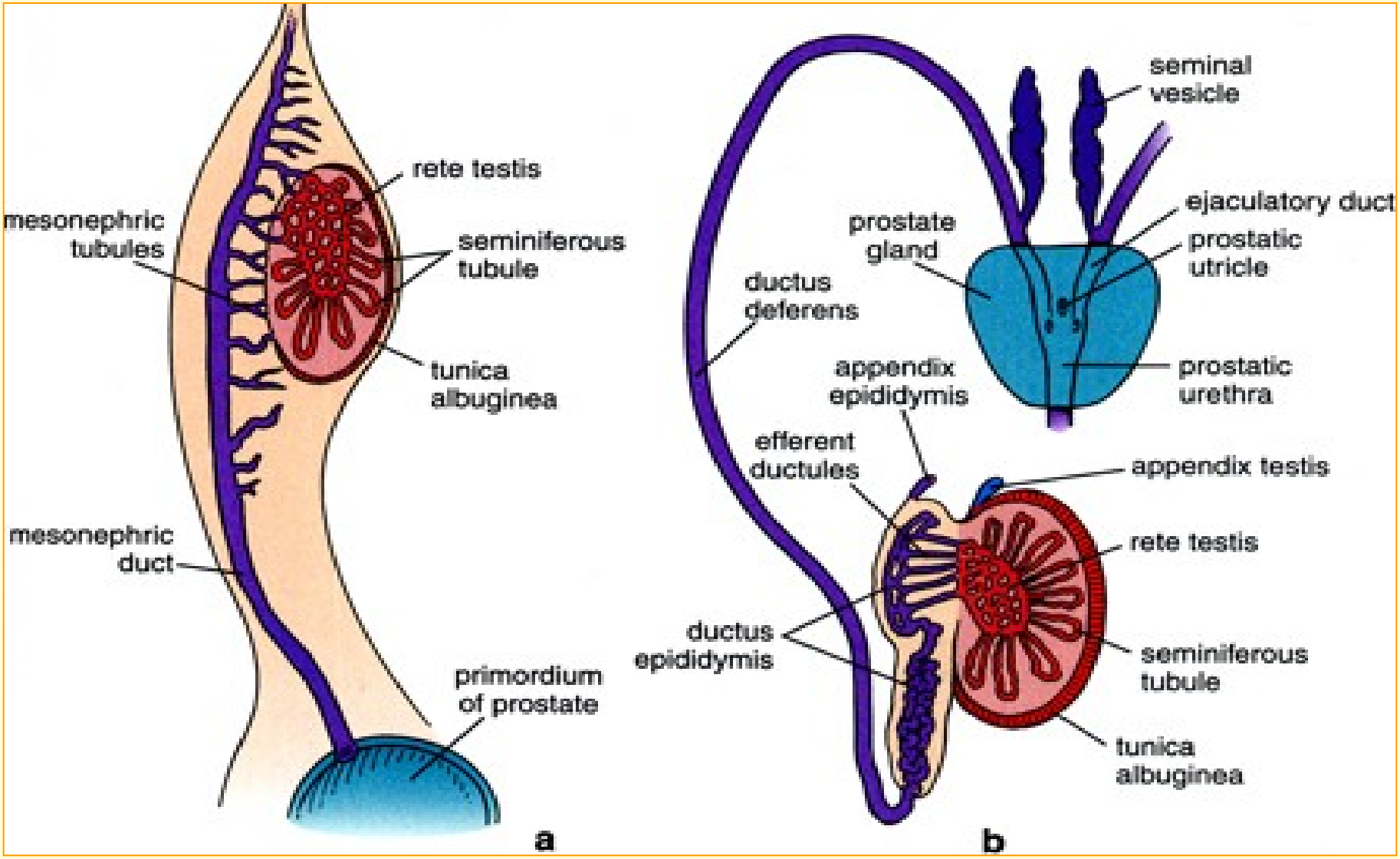


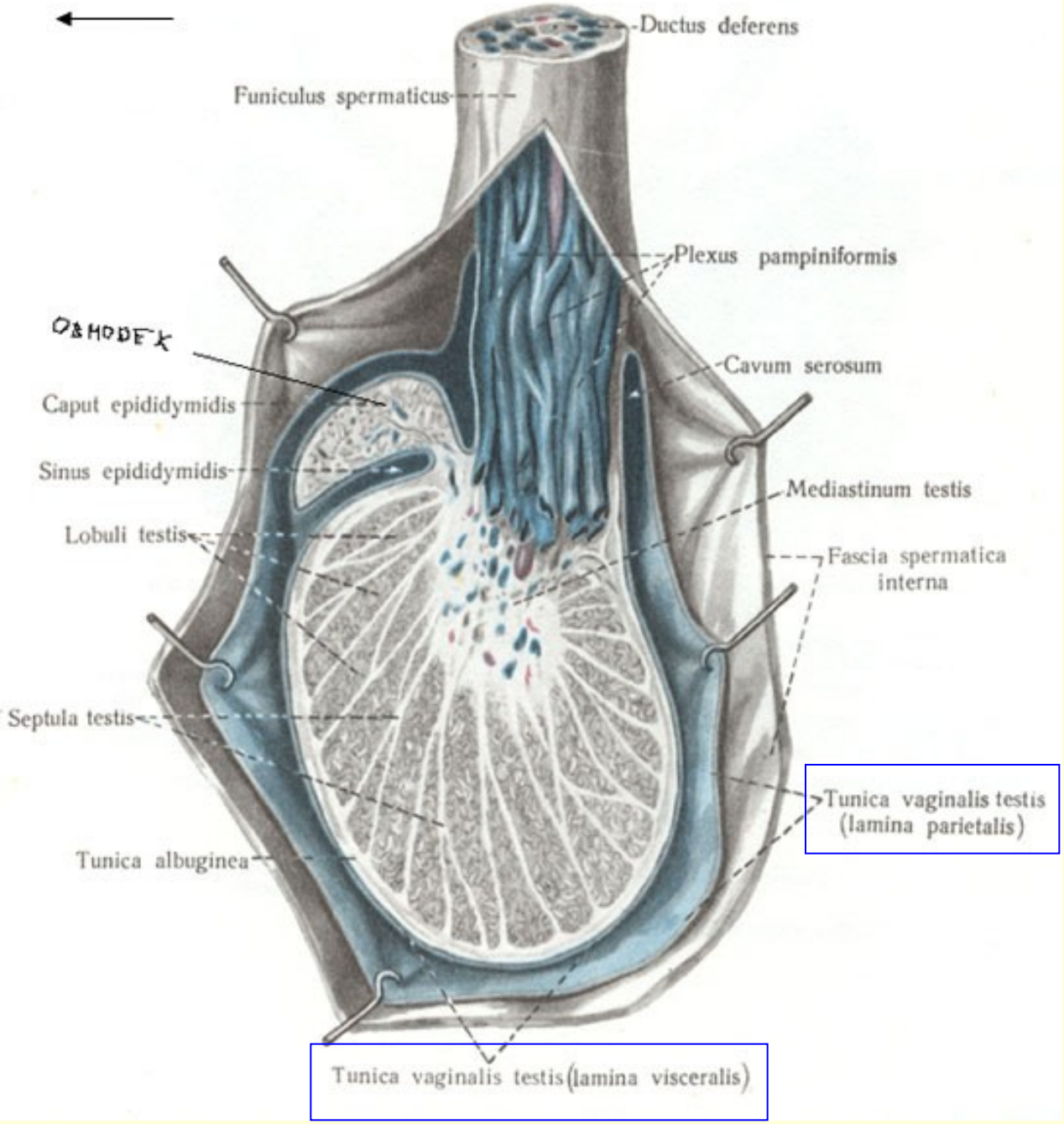
Position of gonads during development

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

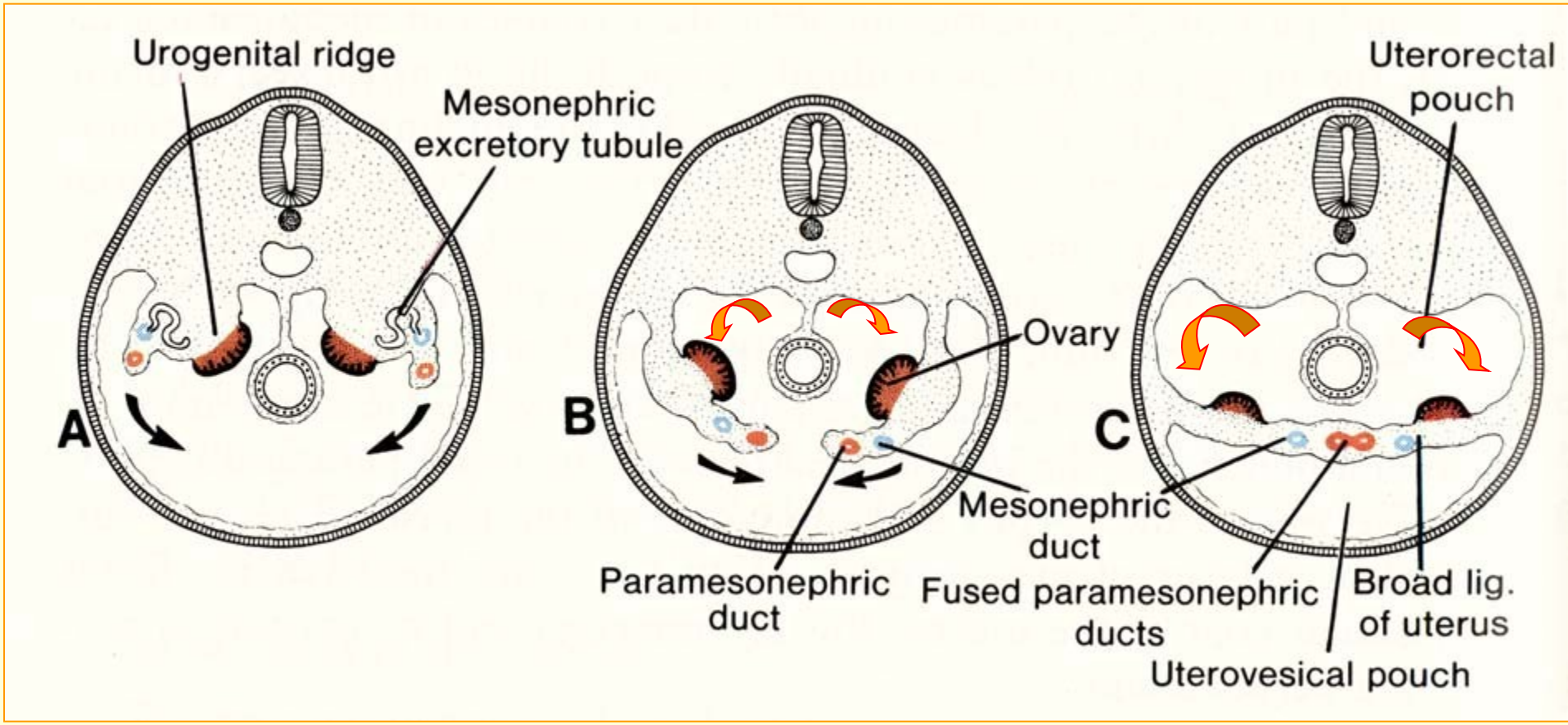
- Testes – descensus into the scrotum
- Ovaries – change also their position due to fusion of Müllerian ducts and formation of broad ligament

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

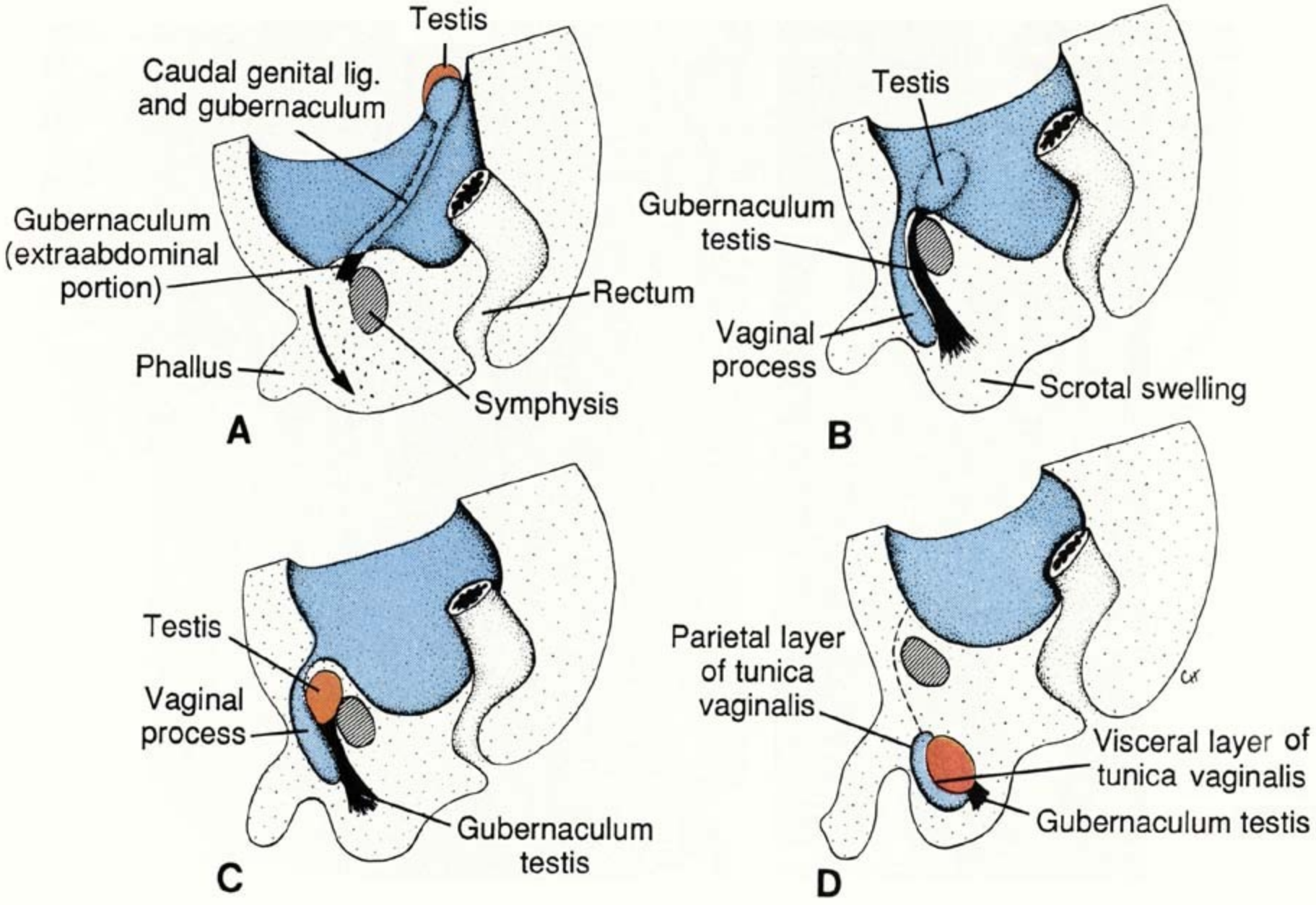


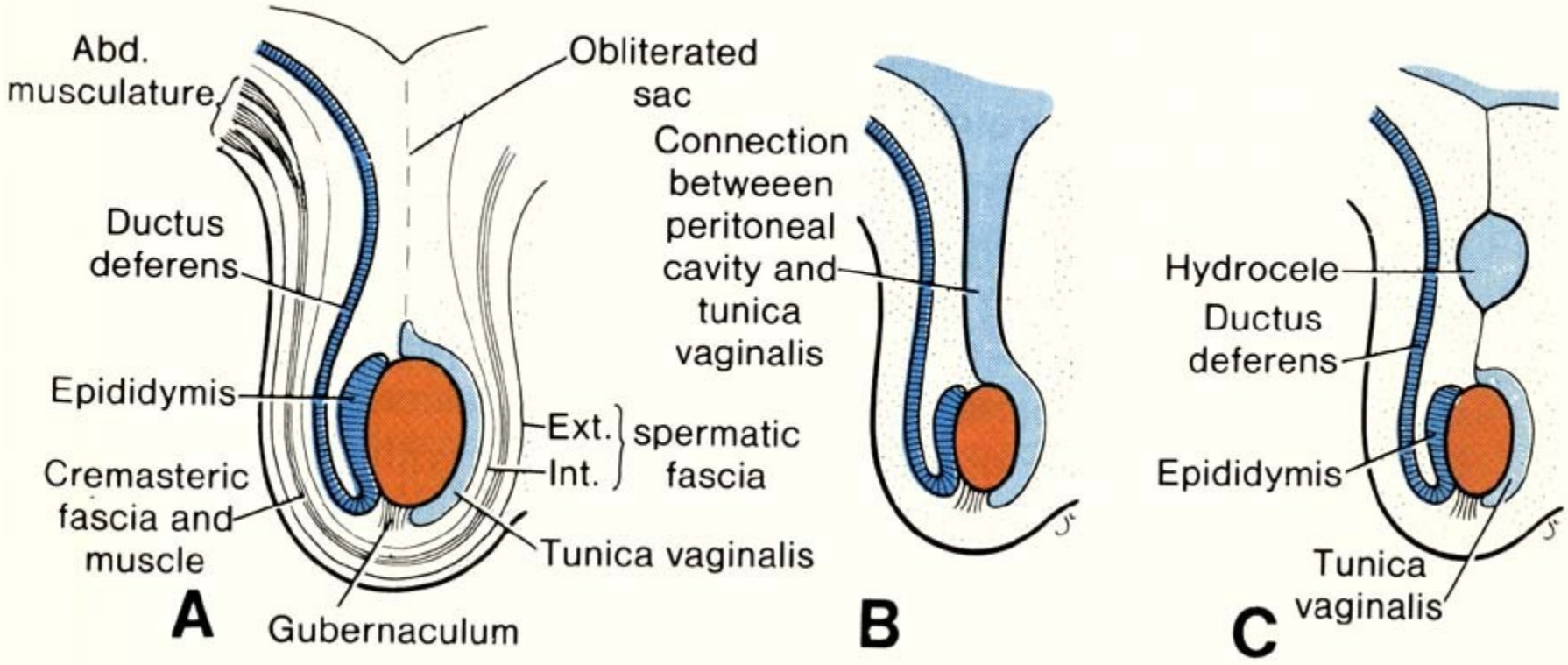
Congenital malformations - 1

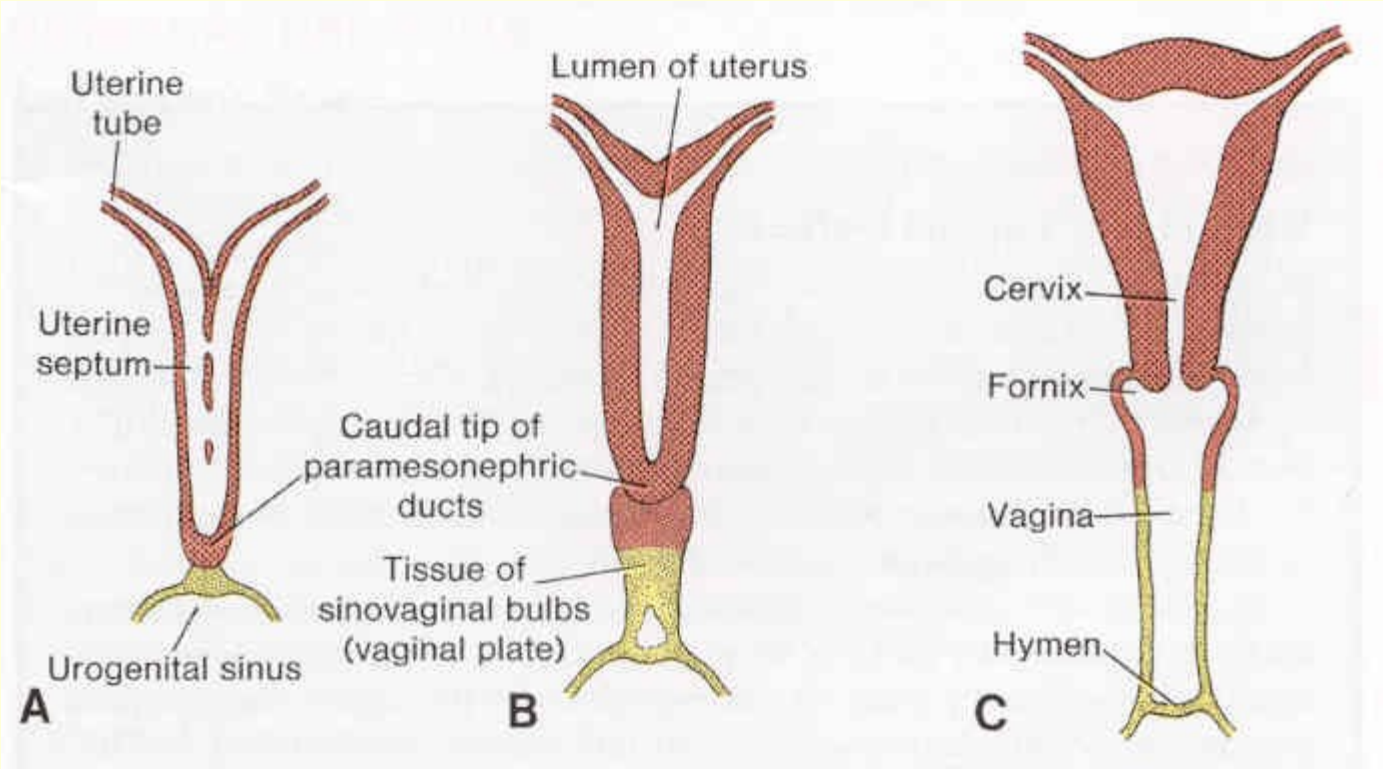
- **Genetic anomalies**:
- Gonad(s) agenesis
- Hermafroditism (ovotestes, ovary+testis) + chromosomal aberations (45X/46XX, 45X/46XY, 47XXY/46X, etc.)
- Pseudohermafroditism – karyotype and gonads do not correspond to external genitalia
- Gonadal hypolasia – Turner sy. (45X0), Klinefelter sy. (47XXY)

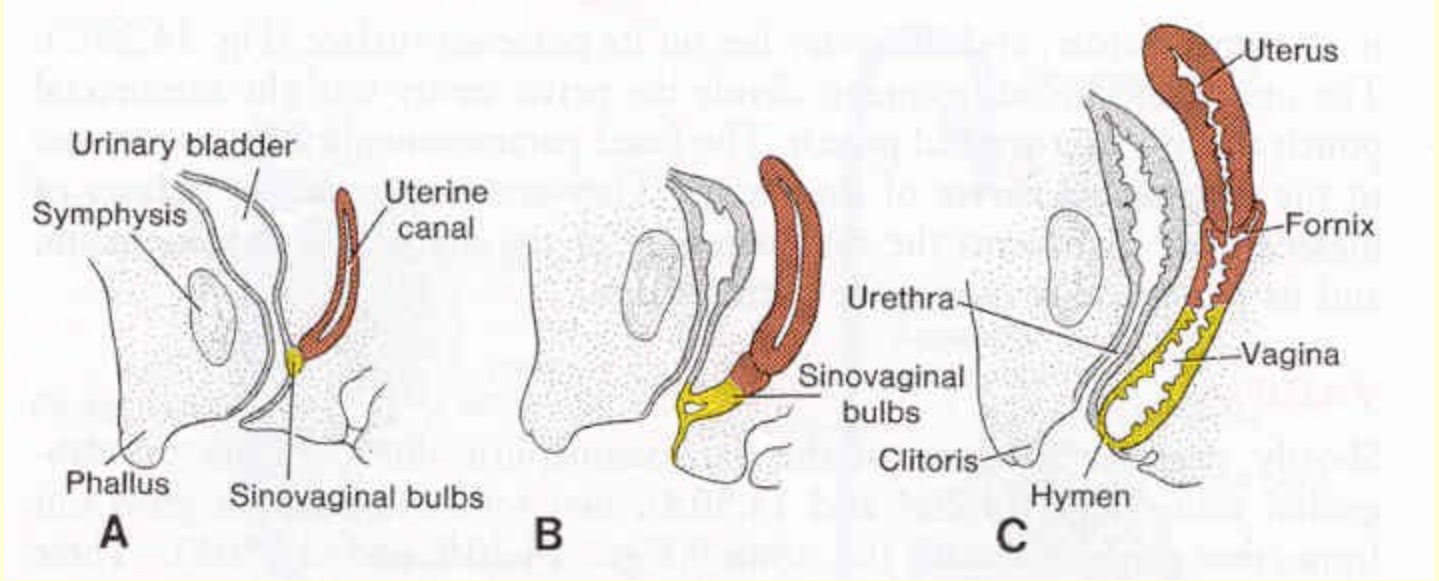
Congenital malformations - 2

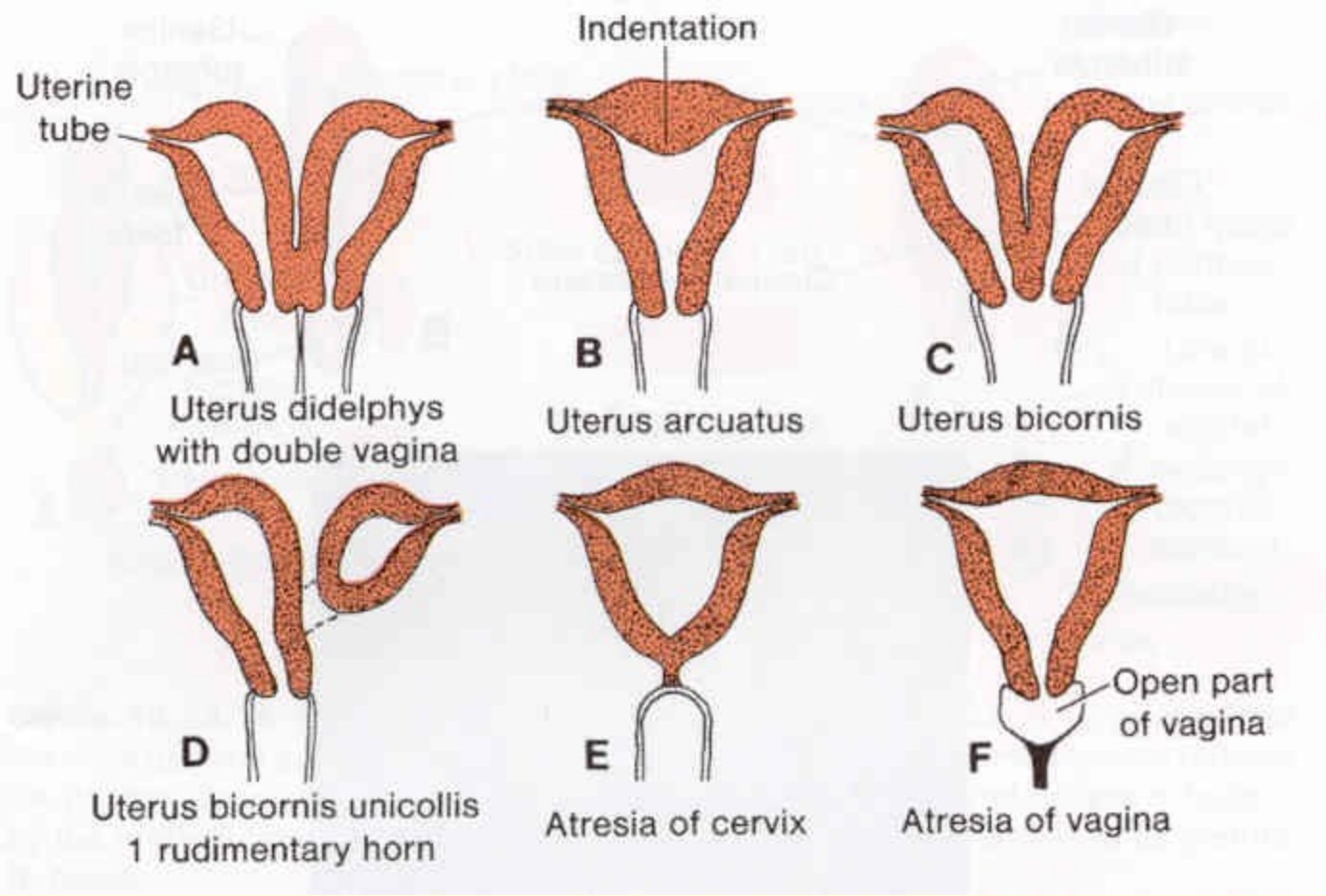
- Kryptorchism
- Hydrocele testis
- Hypospadias, epispadias
- _____
- Developmental defect of uterus (and vagina)
  uterus et vagina separatus, uterus bicornis, uterus septus or subseptus, uterus unicornis etc.


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

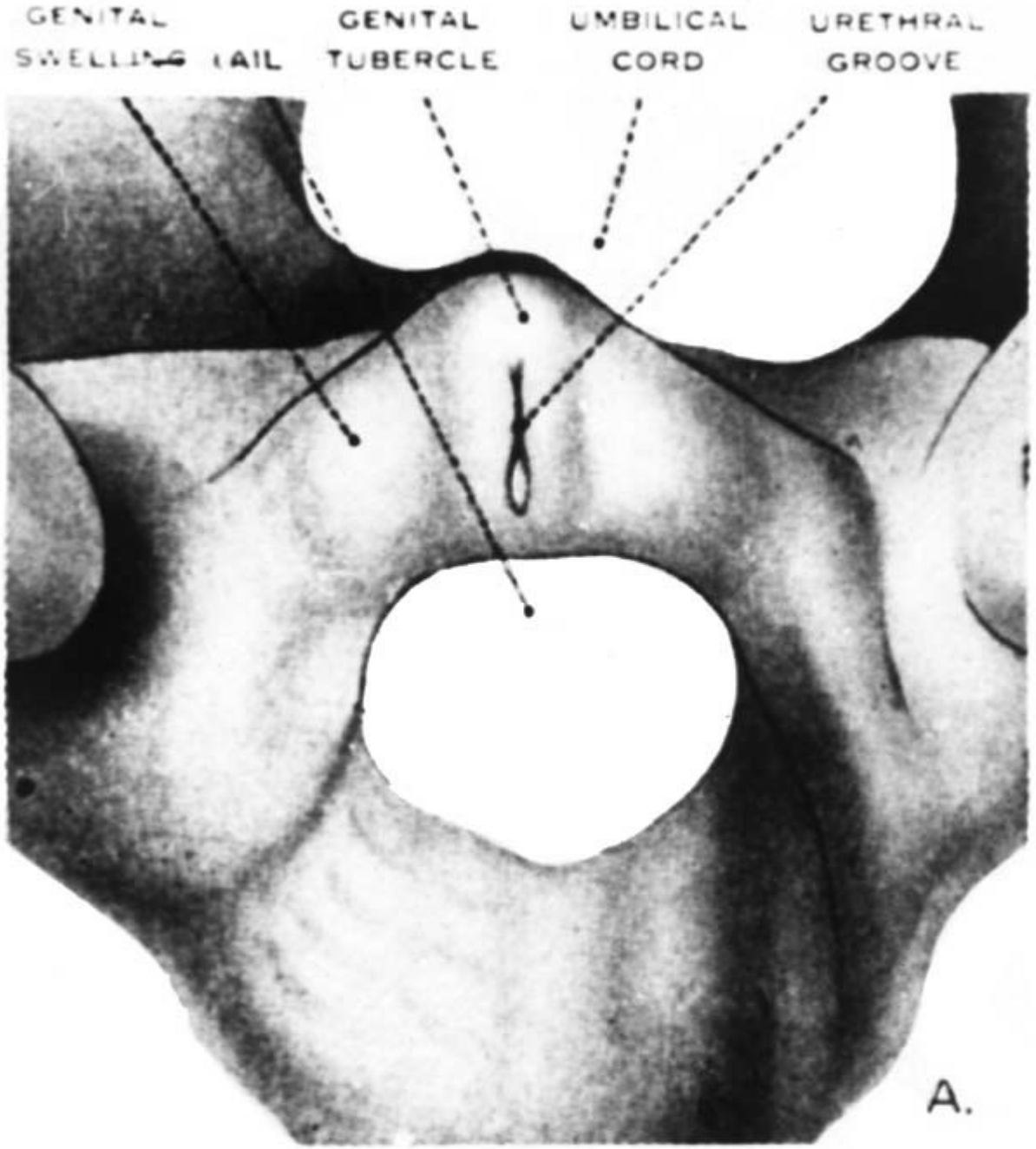

Abd.
musculature
Obliterated
sac
Ductus
deferens
Epididymis
Ext.
Int.
spermatic
fascia
Cremasteric
fascia and
muscle
Tunica vaginalis
A
Gubernaculum
Connection
betweeen
peritoneal
cavity and
tunica
vaginalis
B
Hydrocele
Ductus
deferens
Epididymis
Tunica
vaginalis
C

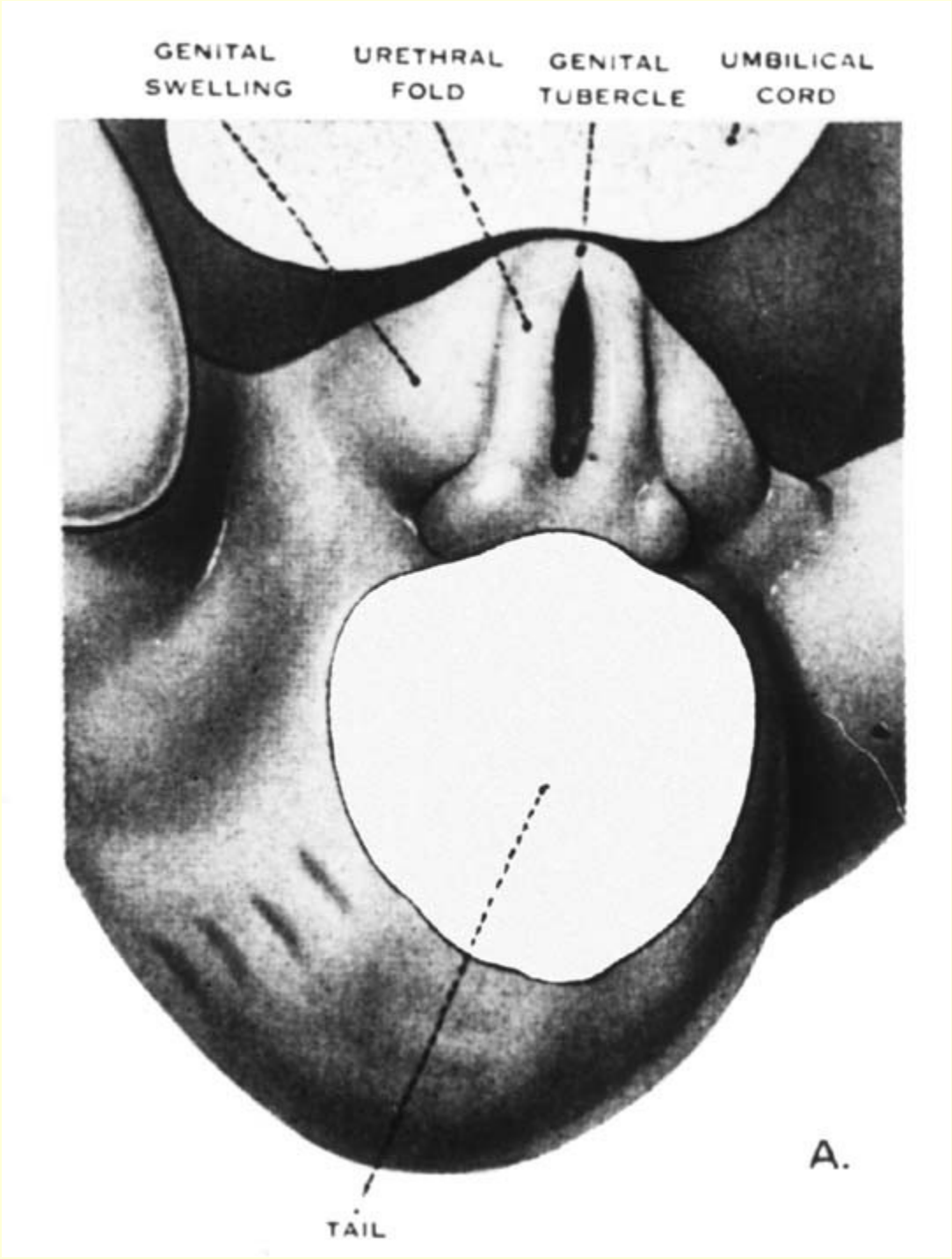

Uterine tube
Uterine septum
Urogenital sinus
A
Lumen of uterus
Caudal tip of paramesonephric ducts
Tissue of sinovaginal bulbs (vaginal plate)
B
Cervix
Fornix
Vagina
Hymen
C


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


GENITAL
SWELLING
TAIL
GENITAL
TUBERCLE
UMBILICAL
CORD
URETHRAL
GROOVE
A.


GENITAL SWELLING
URETHRAL FOLD
GENITAL TUBERCLE
UMBILICAL CORD
TAIL
A.

Repetition of blood

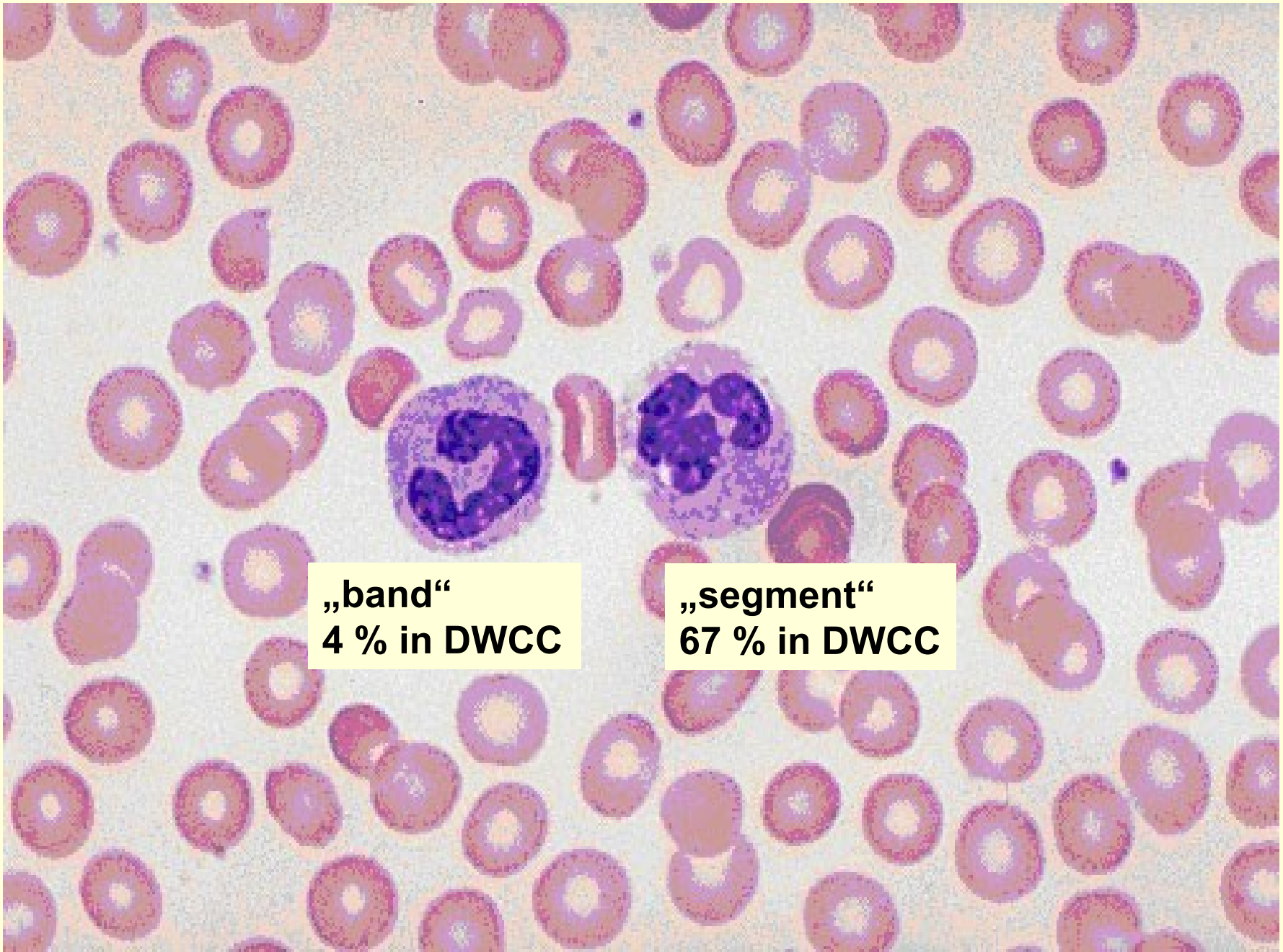
- Composition of the blood
- Hematocrit
- Hemoglobin
- Erythrocytes – shape, size, density per 1 μl
- Reticulocytes
- Anisocytosis
- Poikilocytosis
- Polycythemia (= polyglobulia)

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

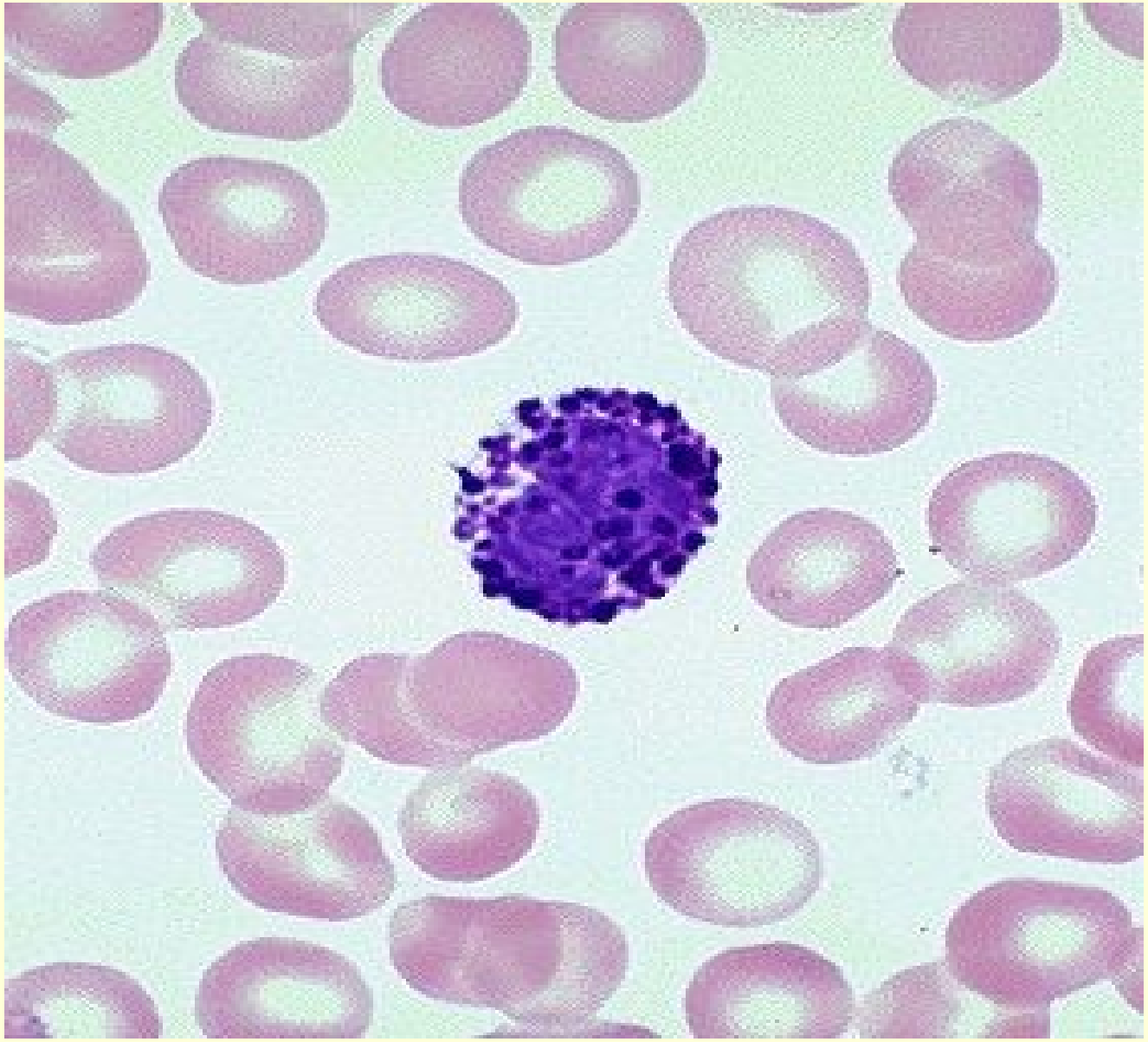
- Bone marrow structure
- Erythropoiesis
- Granulocytopoiesis
- Megakaryocyte
- Endomitosis

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

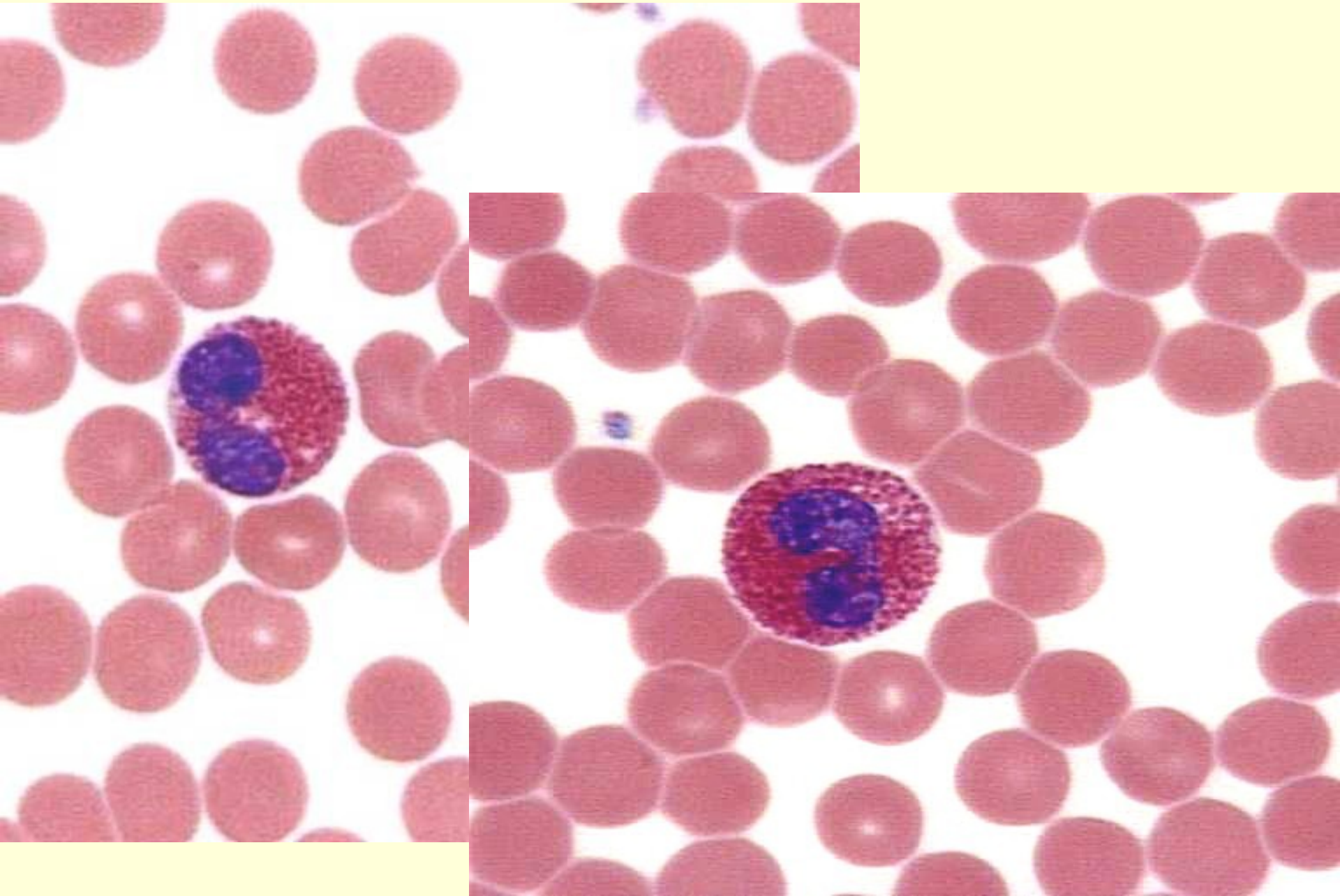
Neutrophilic granulocytes: 10-12 μm in ∅



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



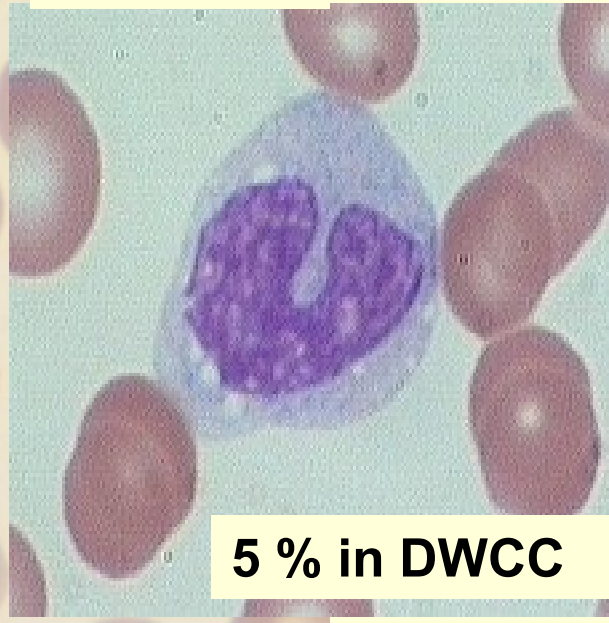
Eosinophilic granulocyte: up to 14 μm in ∅, 3 % in DWCC



Lymfocyte

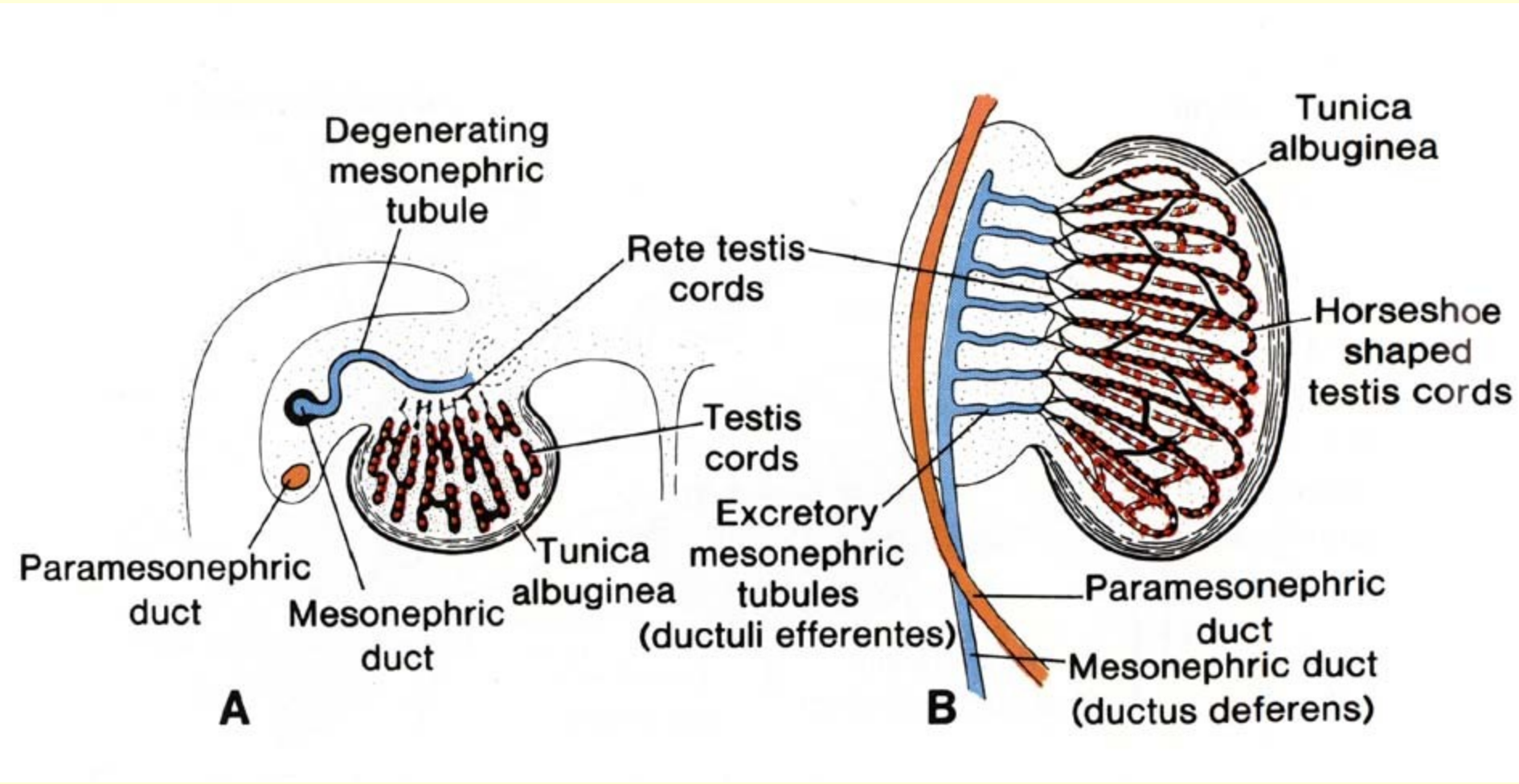
20 % in DWCC

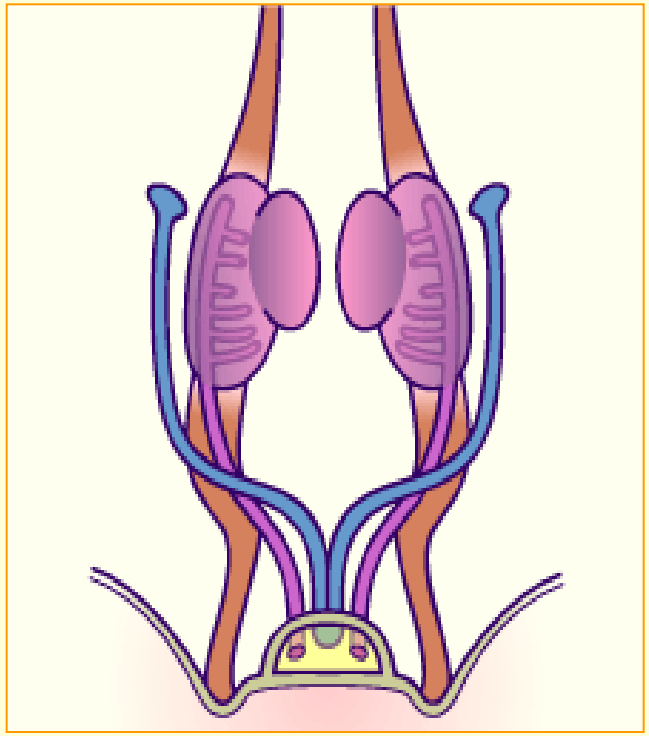
Monocyte

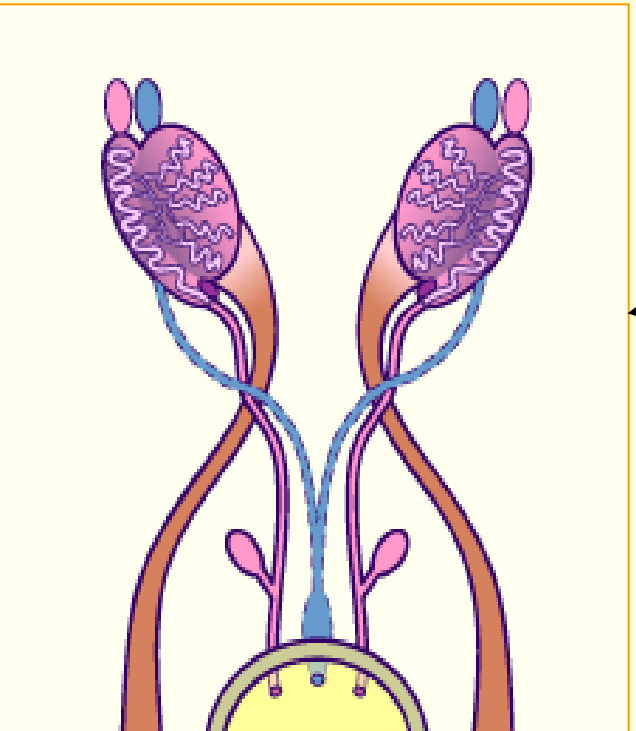


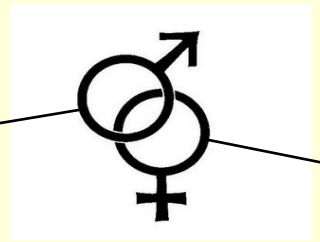
5 % in DWCC

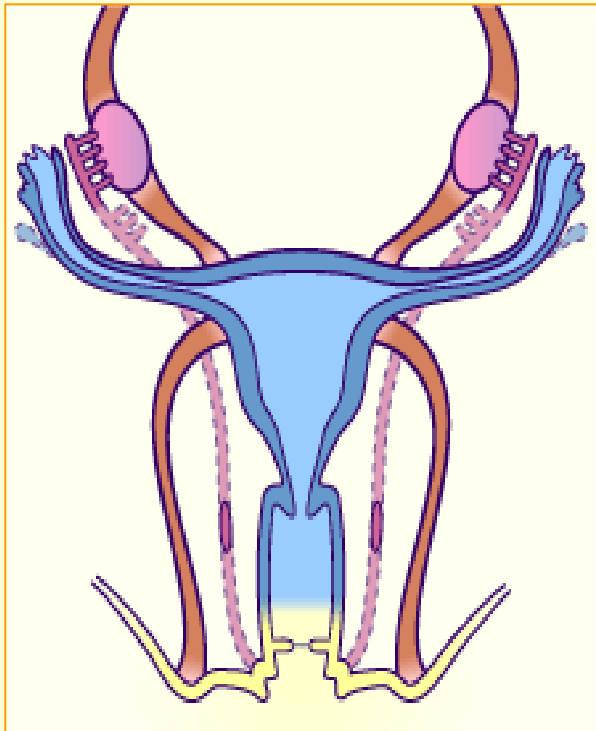

End

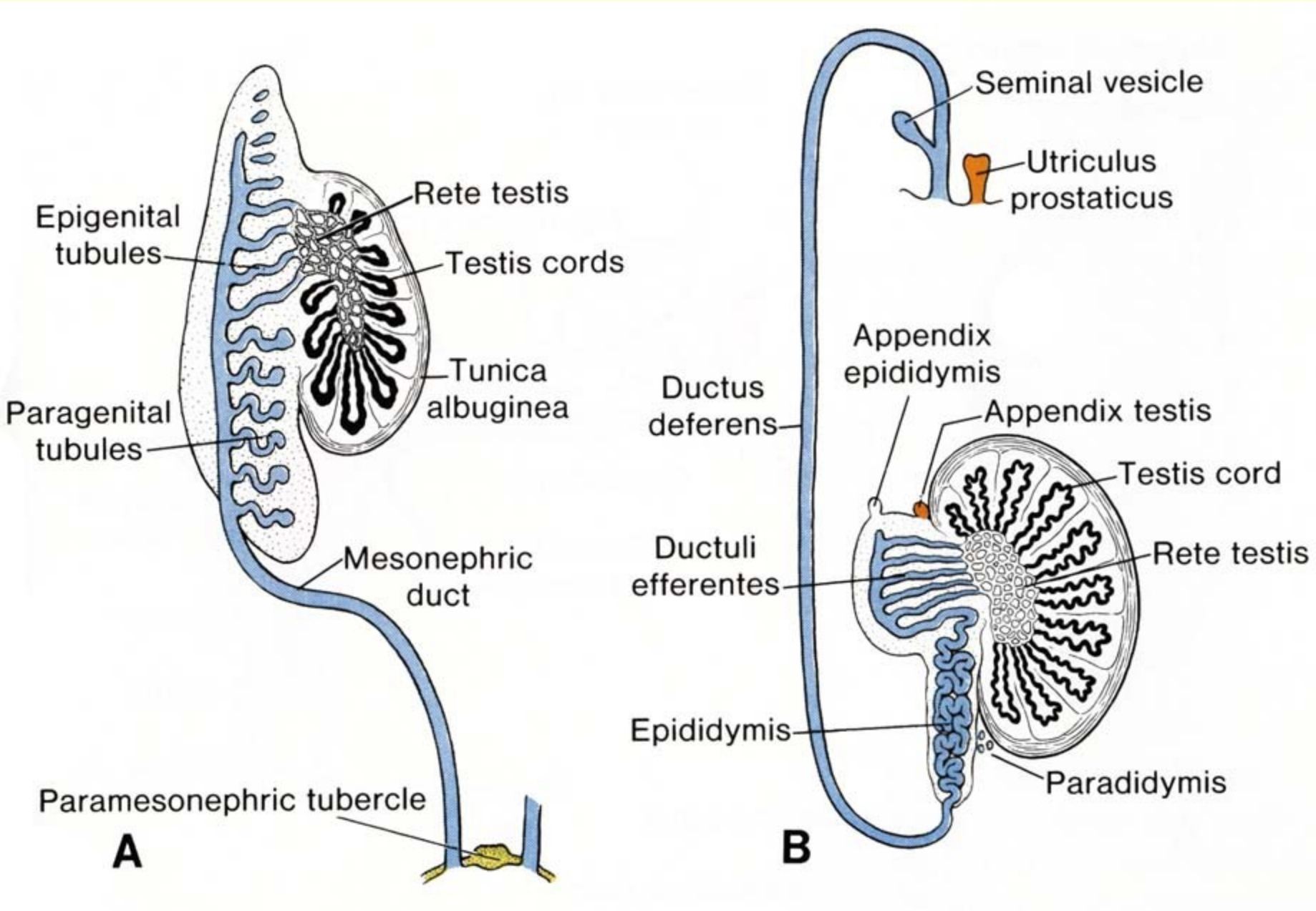

Degenerating mesonephric tubule
Rete testis cords
Testis cords
Tunica albuginea
Paramesonephric duct
Mesonephric duct
A
Tunica albuginea
Horseshoe shaped testis cords
Excretory mesonephric tubules (ductuli efferentes)
Paramesonephric duct
Mesonephric duct (ductus deferens)
B

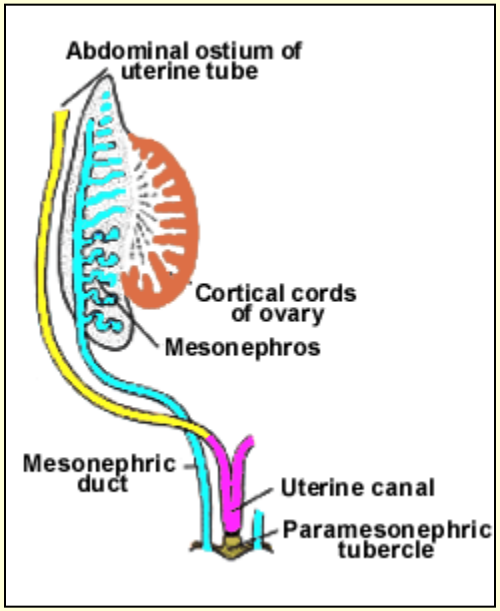


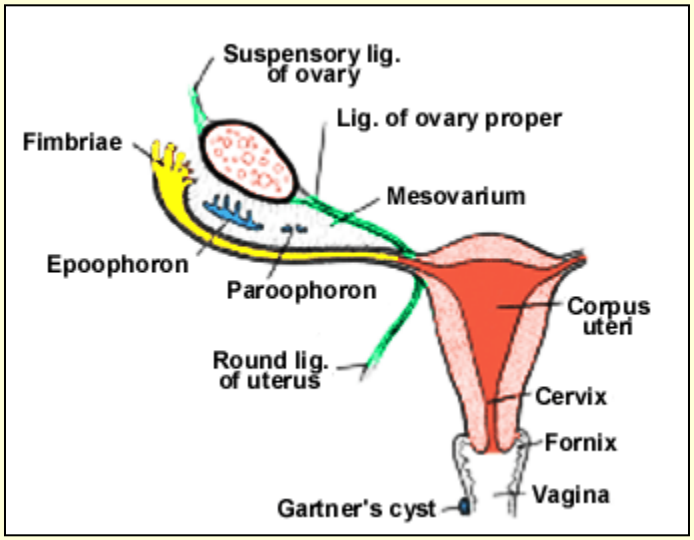


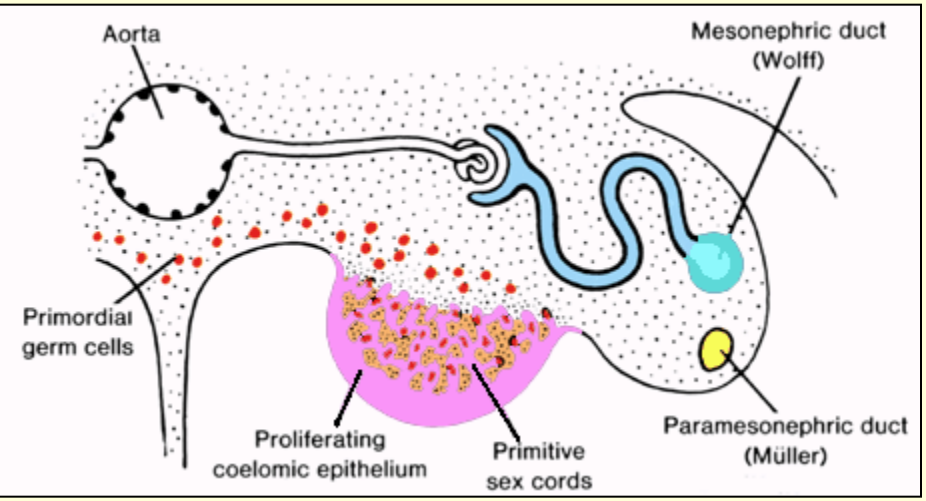


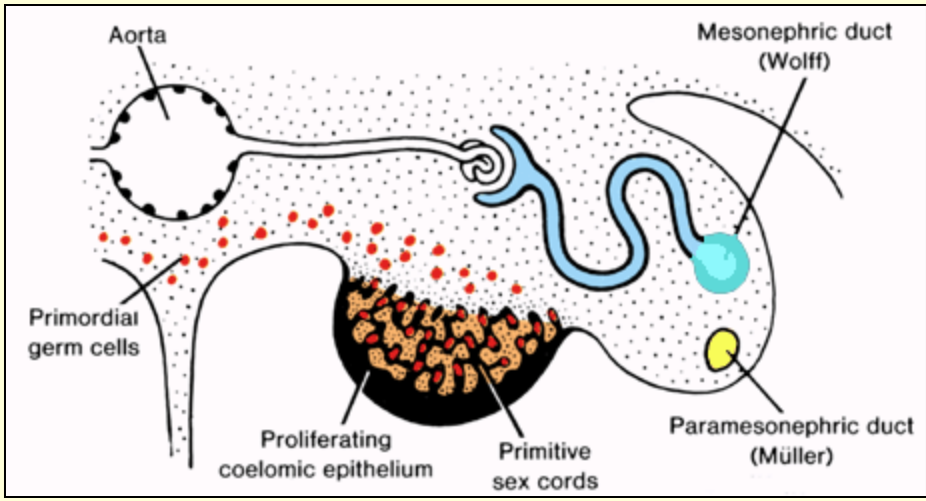


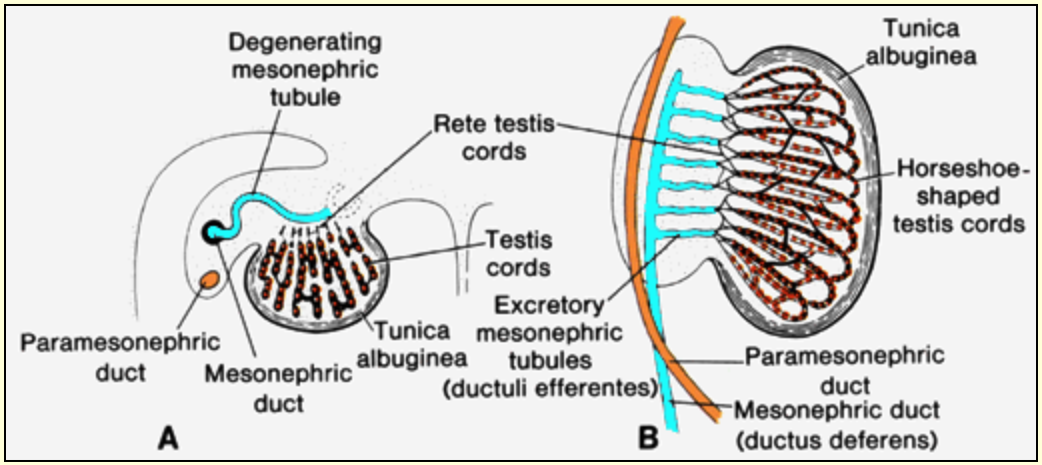

Epigenital tubules
Rete testis
Testis cords
Tunica albuginea
Paragenital tubules
Mesonephric duct
Paramesonephric tubercle
A
Seminal vesicle
Utriculus prostaticus
Appendix epididymis
Ductus deferens
Appendix testis
Testis cord
Ductuli efferentes
Rete testis
Epididymis
Paradidymis
B

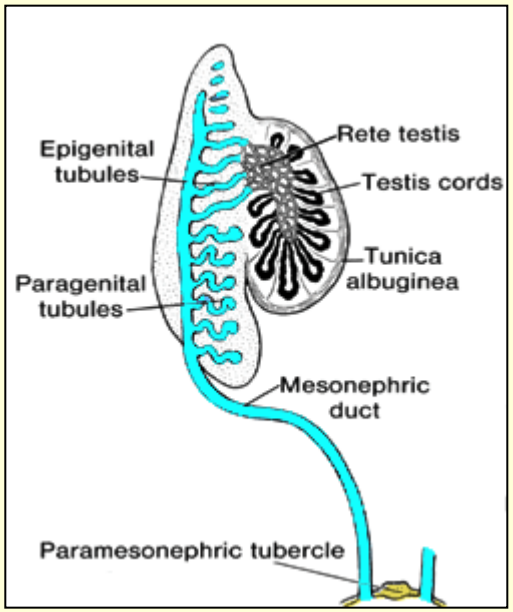

Abdominal ostium of uterine tube
Cortical cords of ovary
Mesonephros
Mesonephric duct
Uterine canal
Paramesonephric tubercle

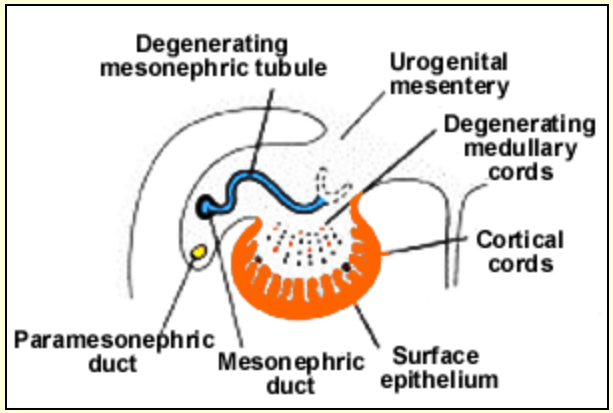

Suspensory lig. of ovary
Lig. of ovary proper
Fimbriae
Mesovarium
Epoophoron
Paroophoron
Corpus uteri
Round lig. of uterus
Cervix
Fornix
Vagina
Gartner's cyst

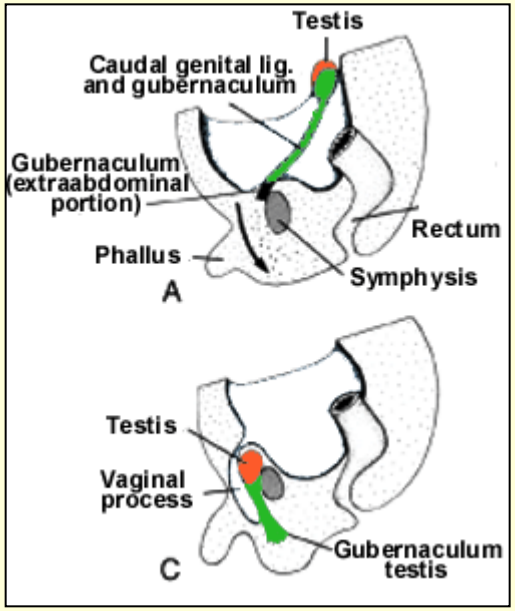

Aorta
Mesonephric duct (Wolff)
Primordial germ cells
Proliferating coelomic epithelium
Primitive sex cords
Paramesonephric duct (Müller)

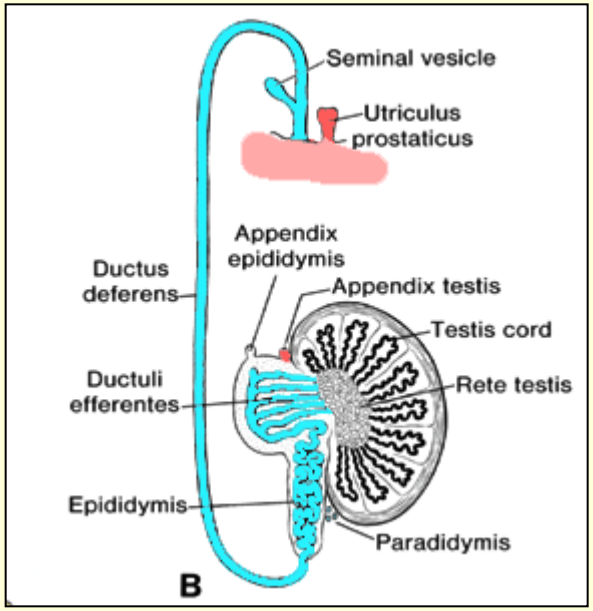

Aorta
Mesonephric duct (Wolff)
Primordial germ cells
Proliferating coelomic epithelium
Primitive sex cords
Paramesonephric duct (Müller)

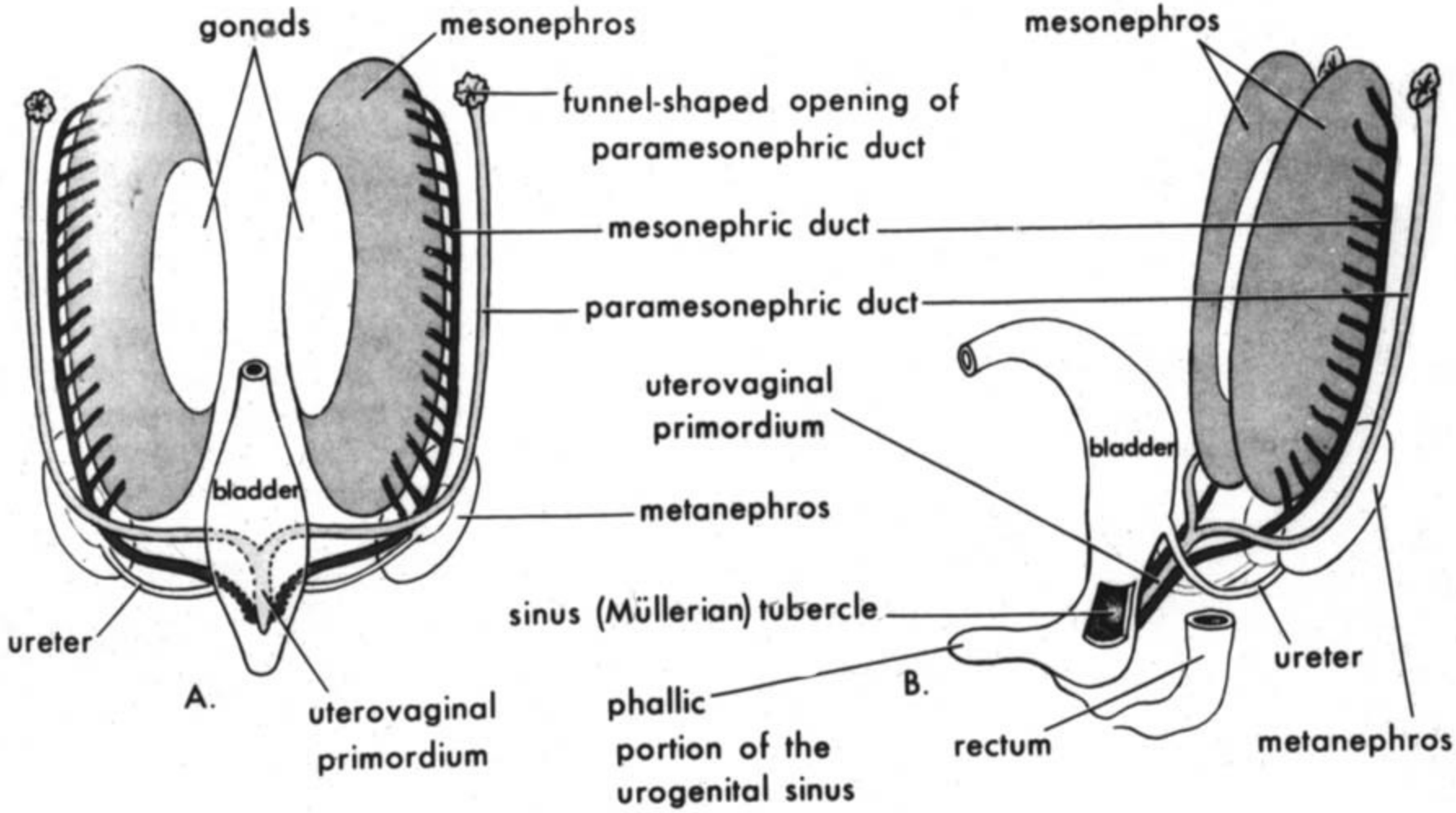

Degenerating mesonephric tubule
Rete testis cords
Testis cords
Paramesonephric duct
Mesonephric duct
Tunica albuginea
A
Tunica albuginea
Horseshoe-shaped testis cords
Excretory mesonephric tubules (ductuli efferentes)
Paramesonephric duct
Mesonephric duct (ductus deferens)
B

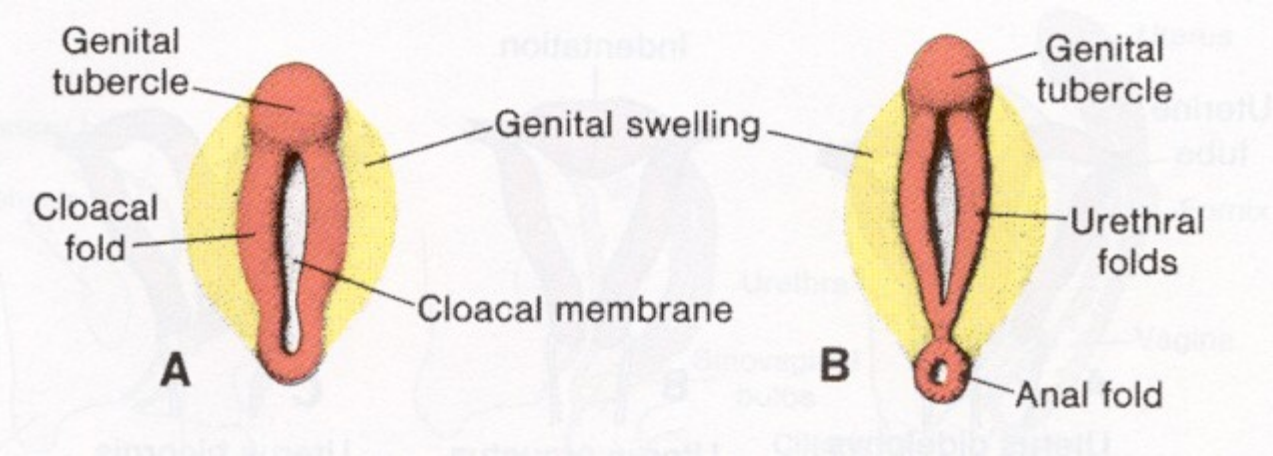

Epigenital tubules
Rete testis
Testis cords
Tunica albuginea
Paragenital tubules
Mesonephric duct
Paramesonephric tubercle

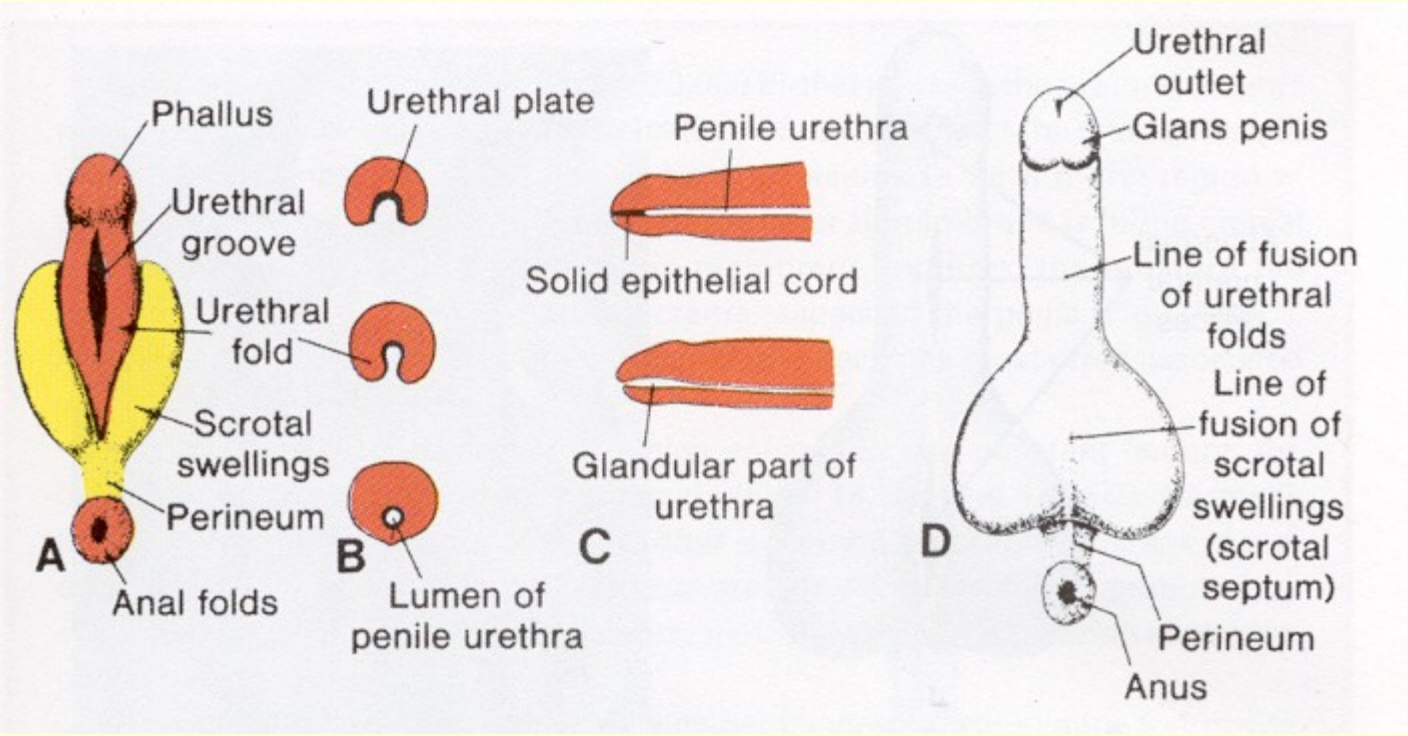

Degenerating mesonephric tubule
Urogenital mesentery
Degenerating medullary cords
Cortical cords
Paramesonephric duct
Mesonephric duct
Surface epithelium

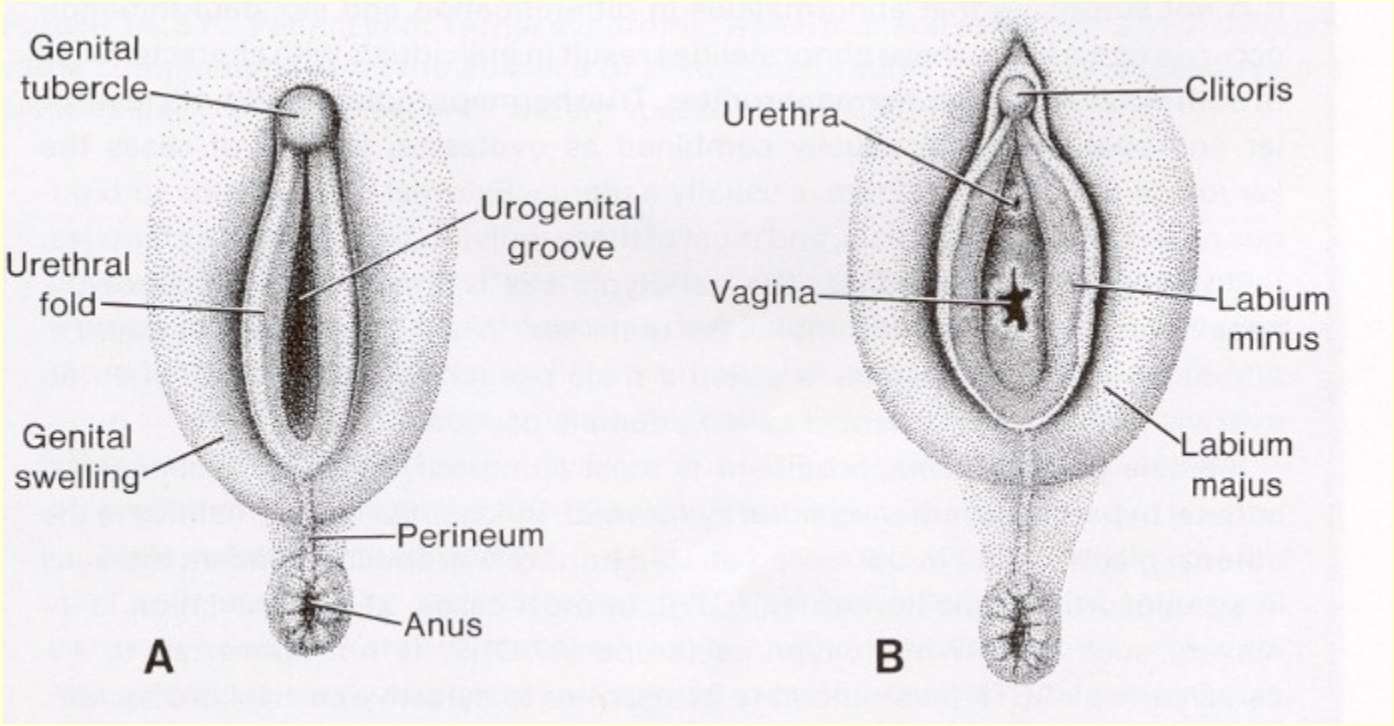

Testis
Caudal genital lig. and gubernaculum
Gubernaculum (extraabdominal portion)
Rectum
Phallus
Symphysis
A
Testis
Vaginal process
Gubernaculum testis
C

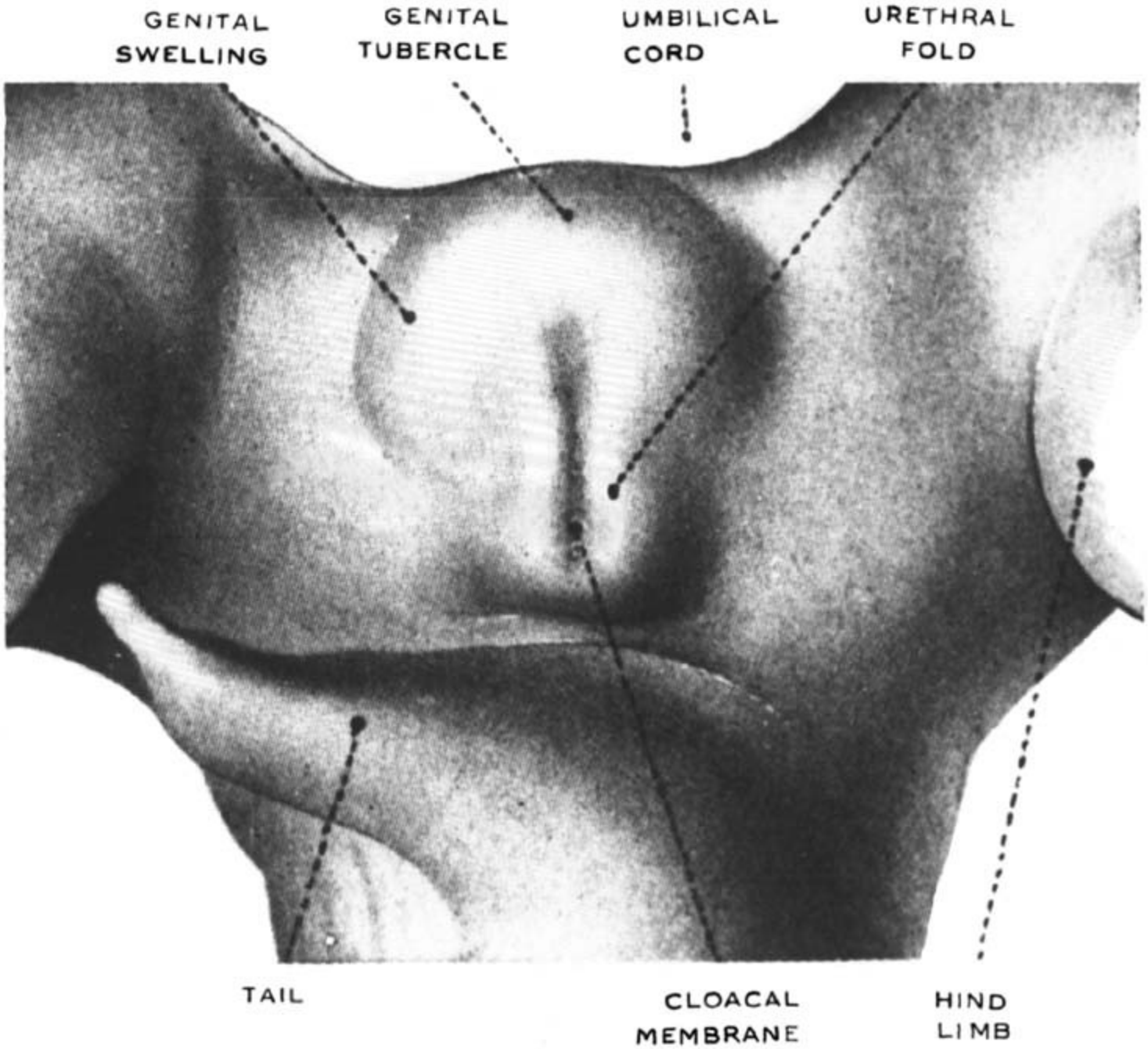

Seminal vesicle
Utriculus prostaticus
Appendix epididymis
Ductus deferens
Appendix testis
Testis cord
Ductuli efferentes
Rete testis
Epididymis
Paradidymis
B

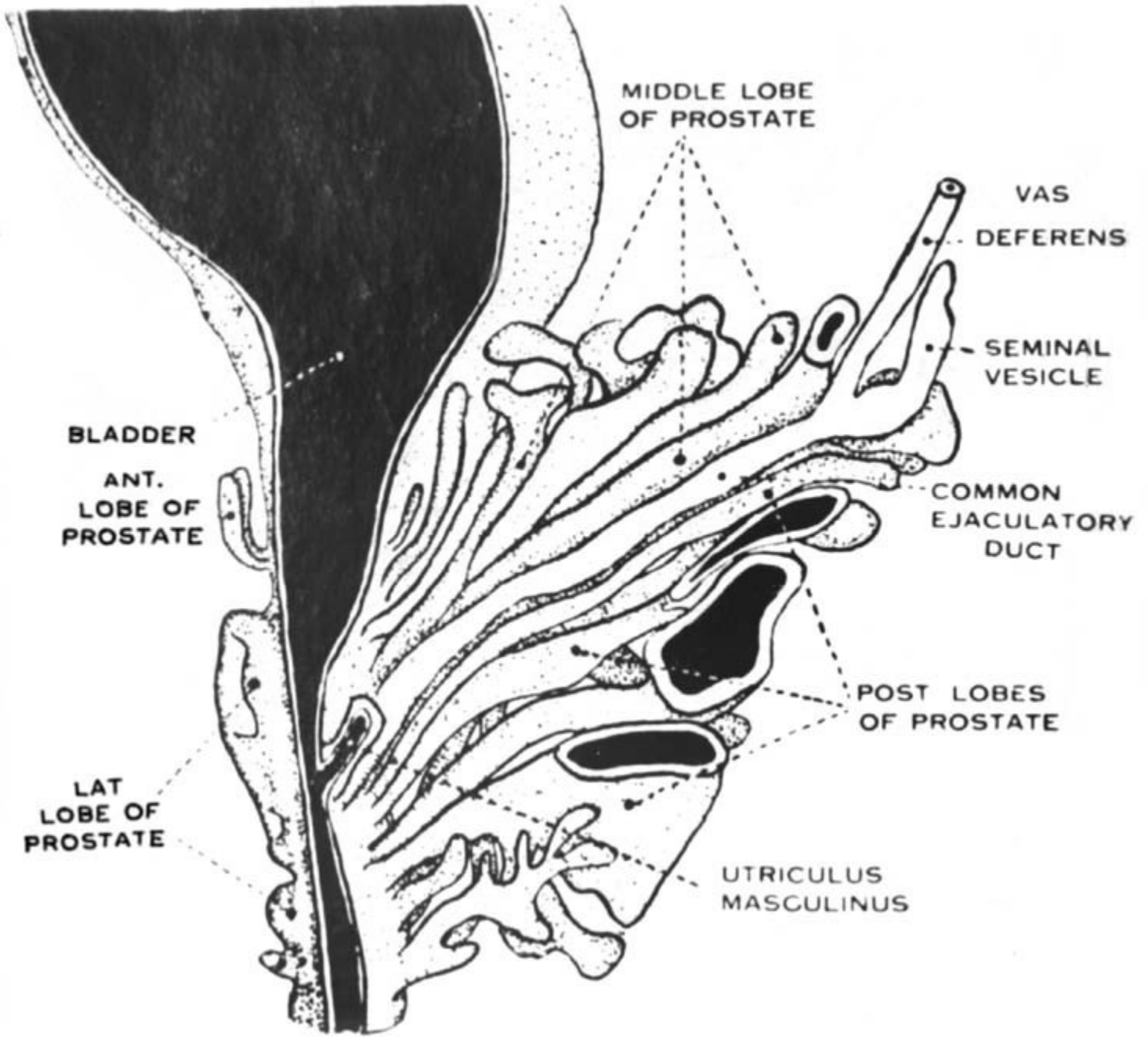

gonads
mesonephros
funnel-shaped opening of paramesonephric duct
mesonephric duct
paramesonephric duct
bladder
metanephros
ureter
A.
uterovaginal primordium
mesonephros
uterovaginal primordium
bladder
sinus (Müllerian) tubercle
ureter
phallic portion of the urogenital sinus
B.
rectum
metanephros

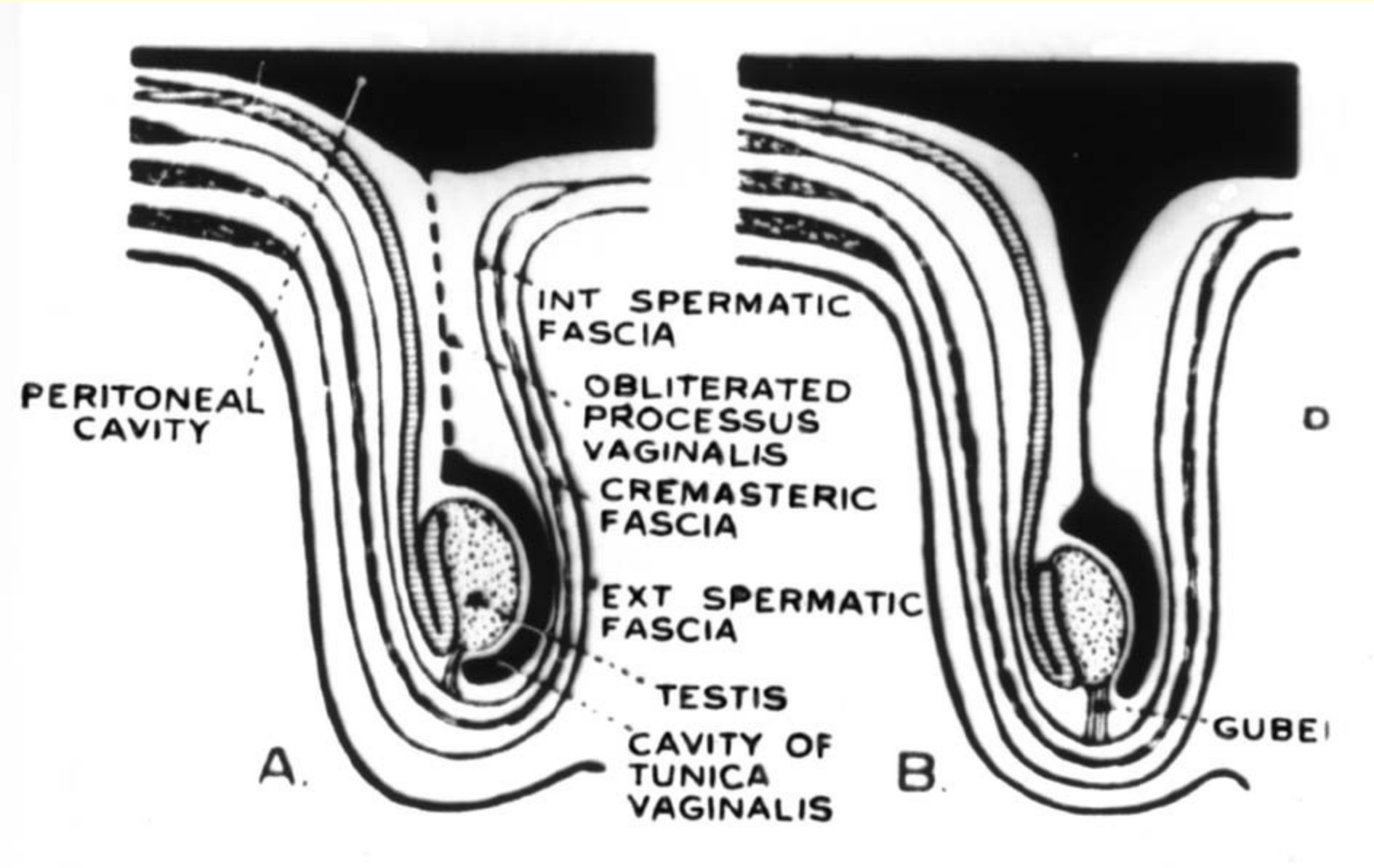

Genital tubercle
Genital swelling
Cloacal fold
Cloacal membrane
A
Genital tubercle
Urethral folds
B
Anal fold

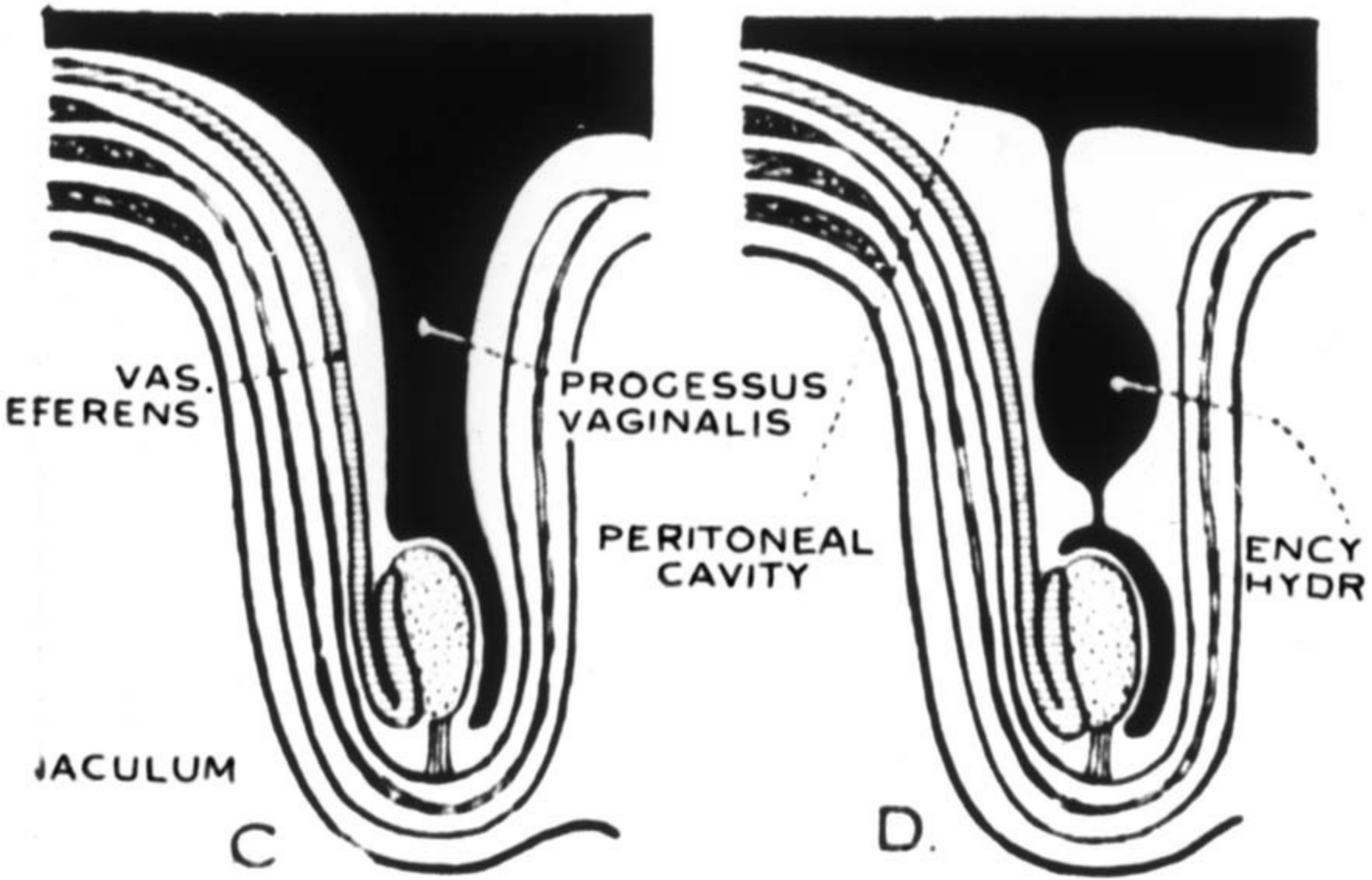

Phallus
Urethral groove
Urethral fold
Scrotal swellings
Perineum
A
Anal folds
Urethral plate
B
Lumen of penile urethra
Penile urethra
Solid epithelial cord
Glandular part of urethra
C
Urethral outlet
Glans penis
Line of fusion of urethral folds
Line of fusion of scrotal swellings (scrotal septum)
D
Perineum
Anus

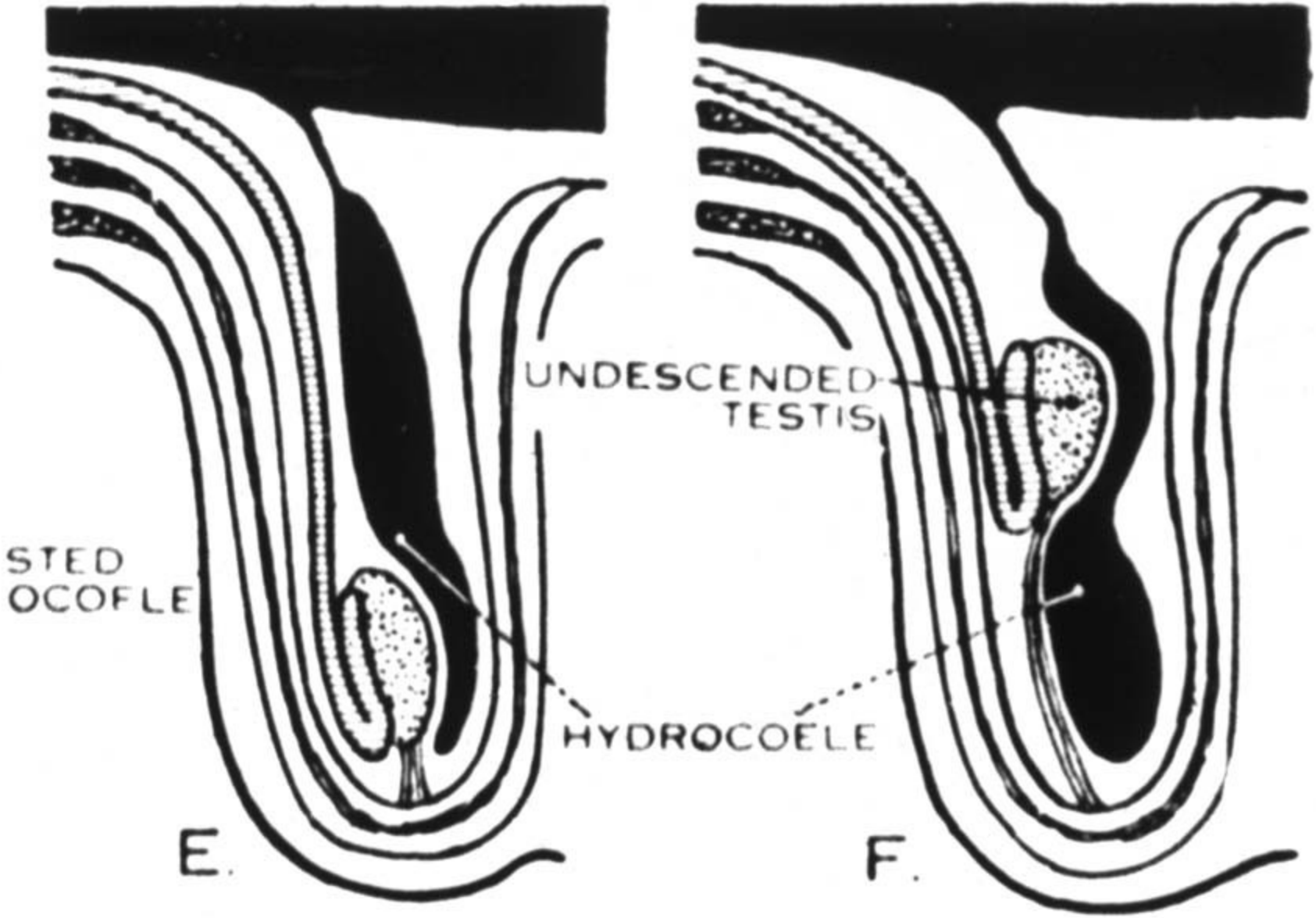

Genital tubercle
Urogenital groove
Urethral fold
Genital swelling
Perineum
Anus
A
Urethra
Clitoris
Vagina
Labium minus
Labium majus
B

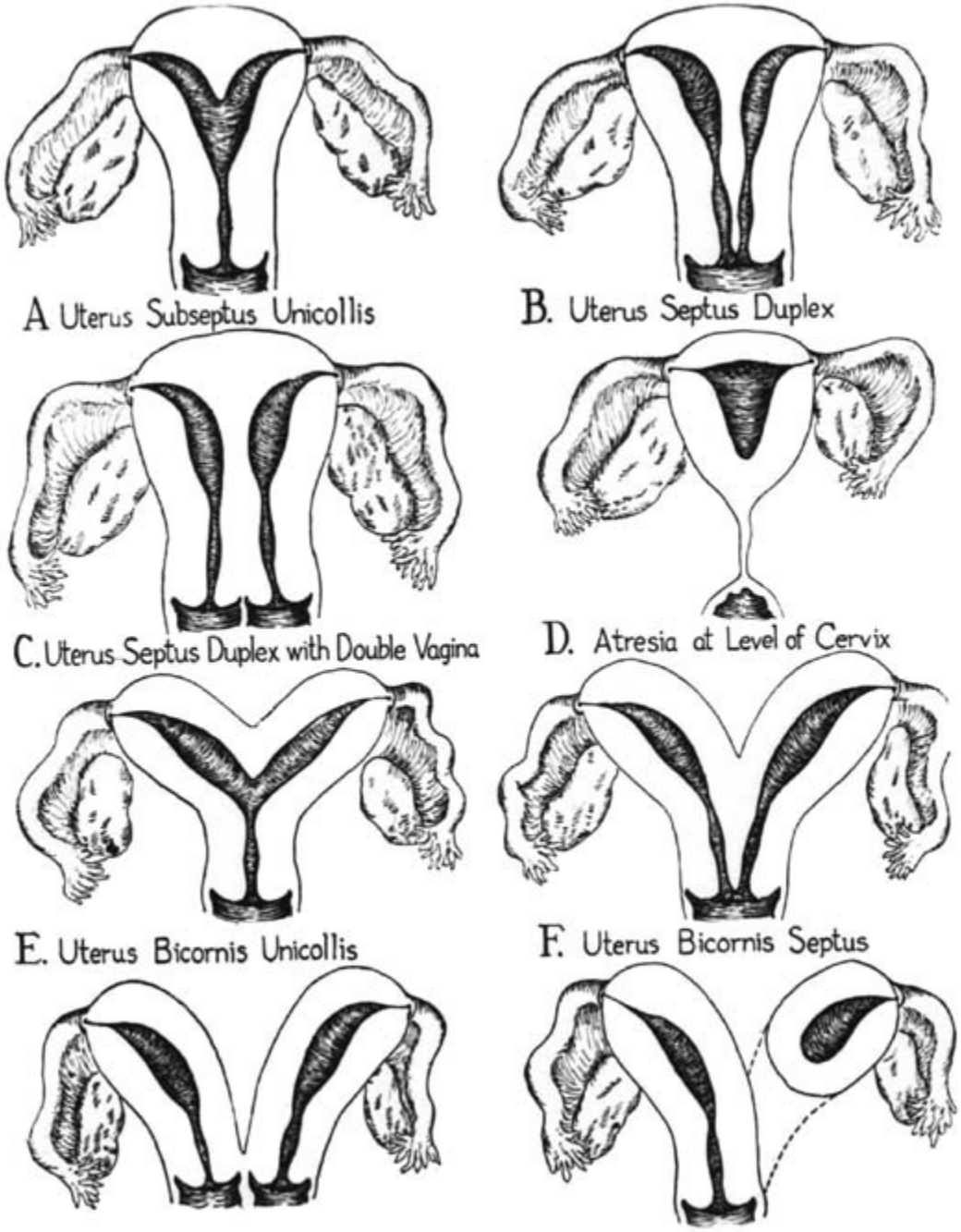

GENITAL SWELLING
GENITAL TUBERCLE
UMBILICAL CORD
URETHRAL FOLD
TAIL
CLOACAL MEMBRANE
HIND LIMB

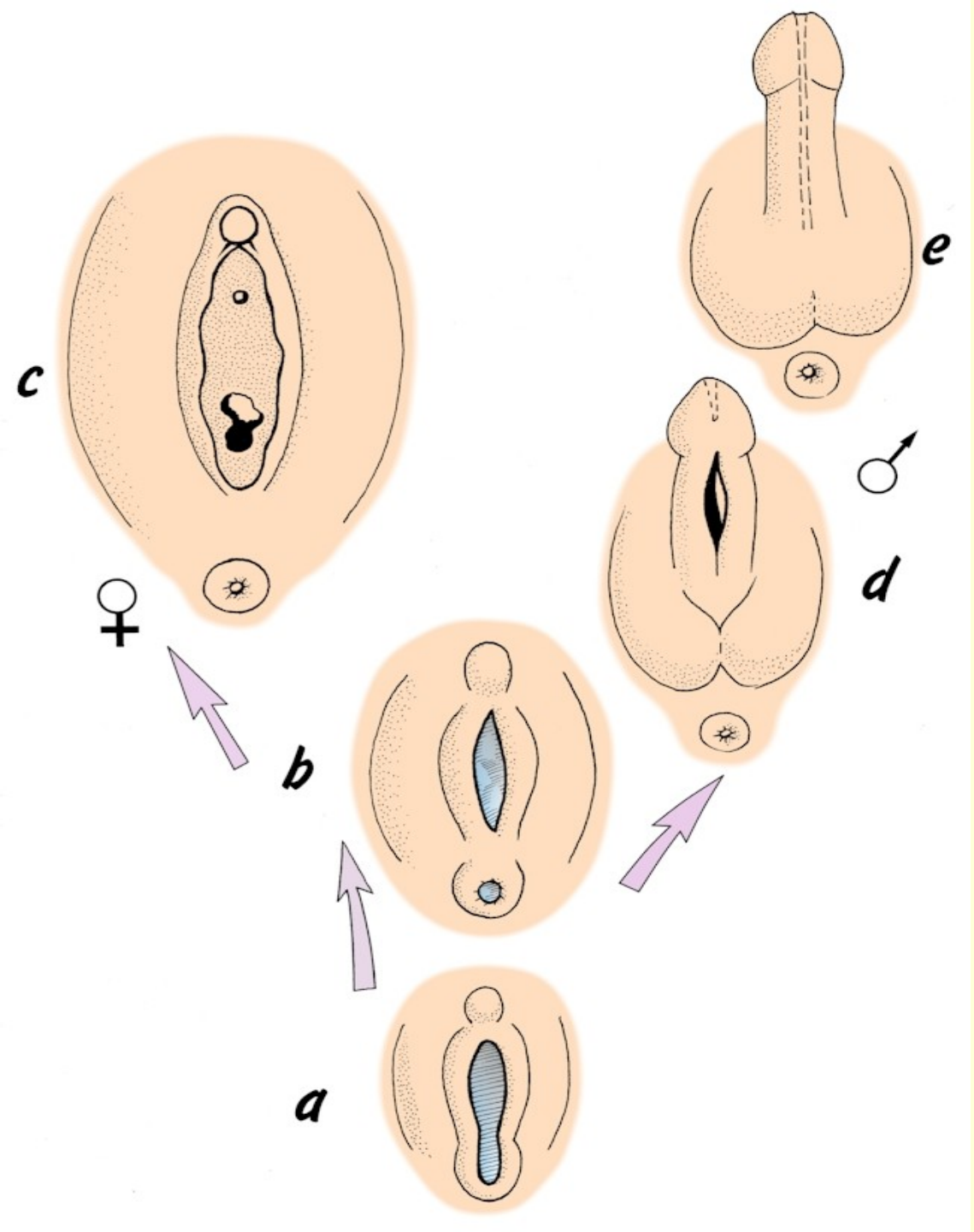

MIDDLE LOBE
OF PROSTATE
VAS
DEFERENS
SEMINAL
VESICLE
BLADDER
ANT.
LOBE OF
PROSTATE
COMMON
EJACULATORY
DUCT
POST LOBES
OF PROSTATE
LAT
LOBE OF
PROSTATE
UTRICULUS
MASCULINUS

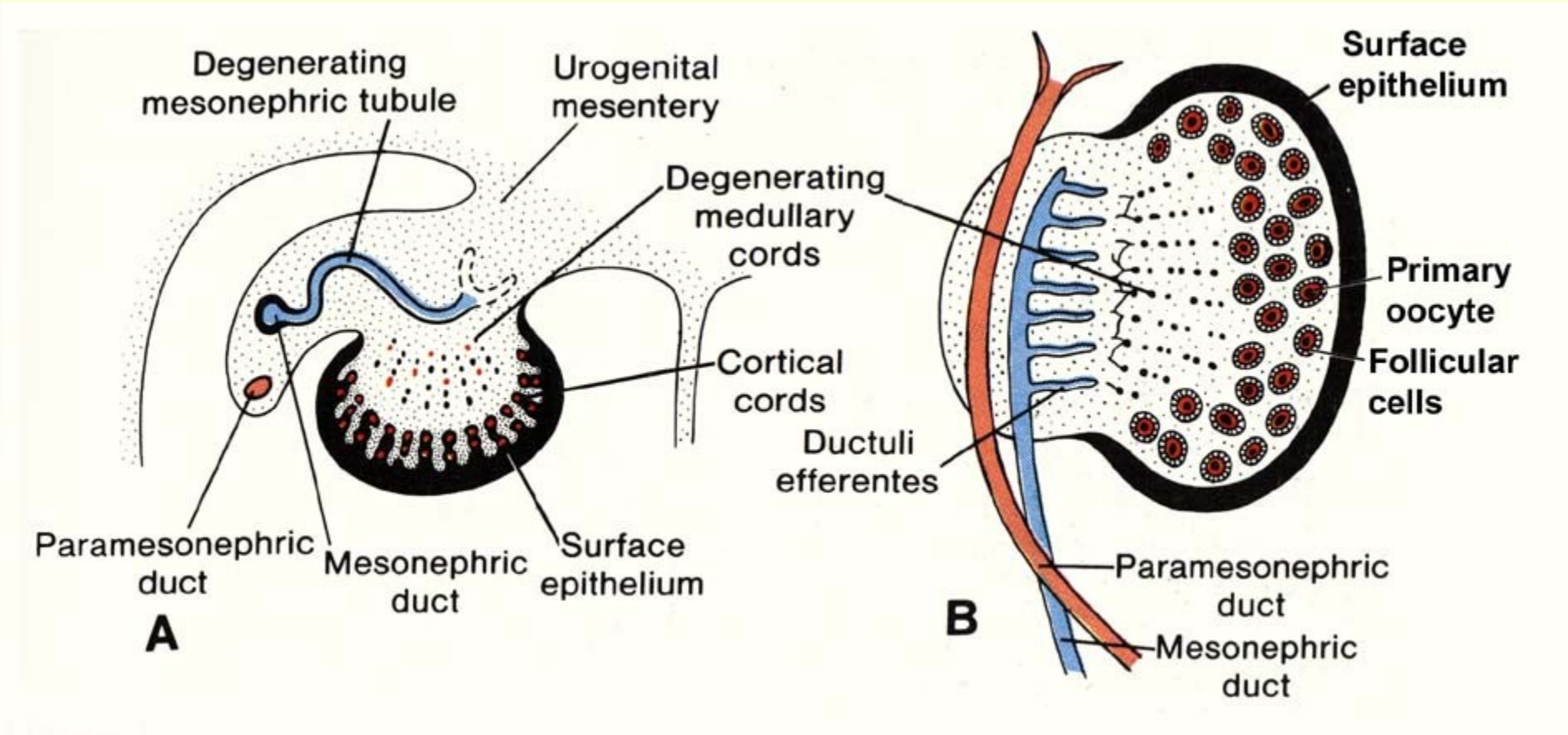

PERITONEAL CAVITY
INT SPERMATIC FASCIA
OBLITERATED PROCESSUS VAGINALIS
CREMASTERIC FASCIA
EXT SPERMATIC FASCIA
TESTIS
CAVITY OF TUNICA VAGINALIS
A.
B.
D
GUBE


VAS.
EFERENS
PROCESSUS
VAGINALIS
PERITONEAL
CAVITY
ENCY
HYDR
JACULUM
C
D.


STED
OCOFLE
E.
UNDESCENDED
TESTIS
HYDROCOÉLE
F.


A Uterus Subseptus Unicollis
B. Uterus Septus Duplex
C. Uterus Septus Duplex with Double Vagina
D. Atresia at Level of Cervix
E. Uterus Bicornis Unicollis
F. Uterus Bicornis Septus


c
e
♀
♂
b
d
a


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