

Embryology of **Urogenital System**

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Sasaran Pembelajaran

Setelah mengikuti kegiatan perkuliahan ini, mahasiswa dapat memahami dan menjelaskan tentang:

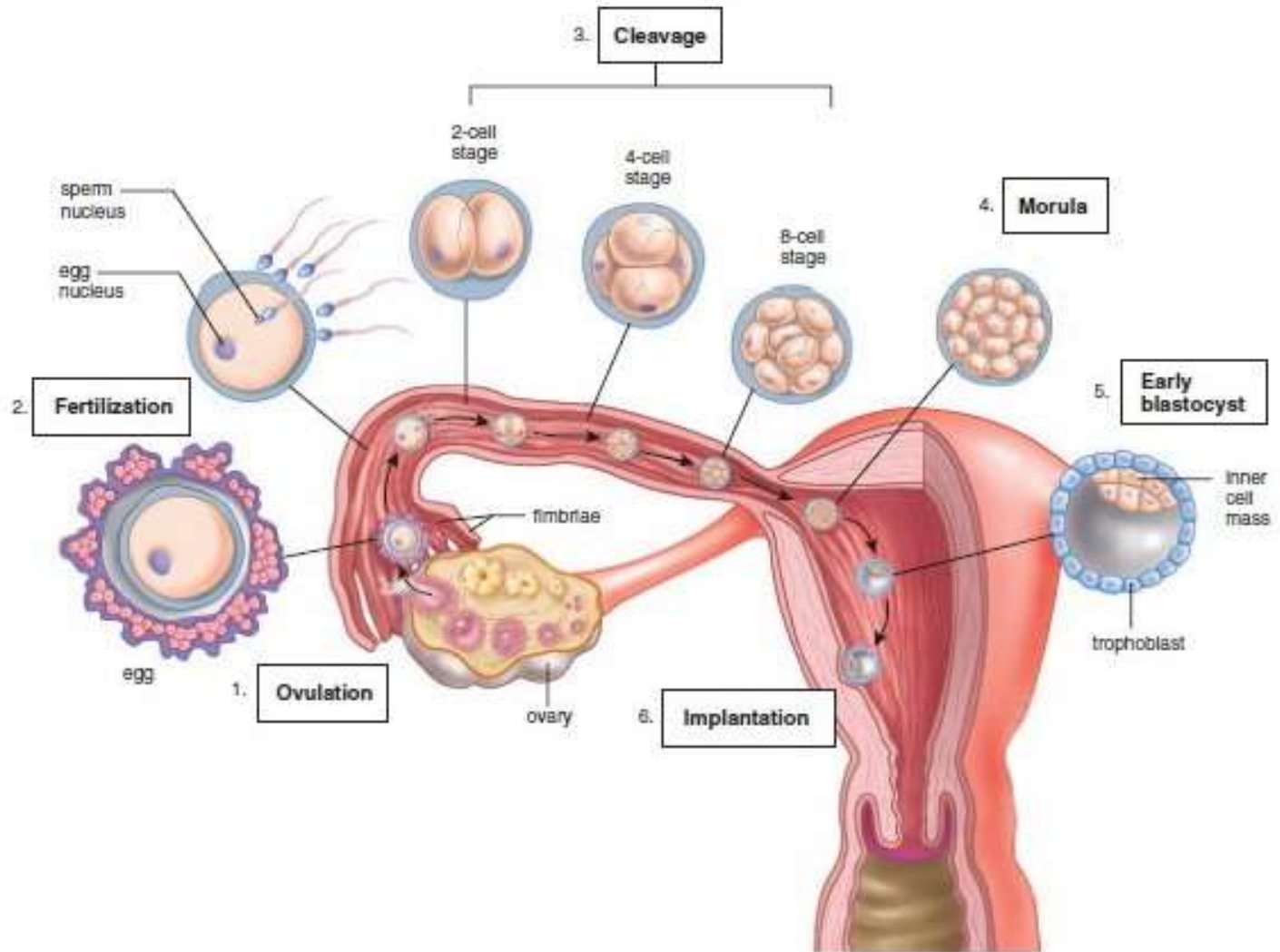
1. Overview embriologi umum dan germinal layers
2. Perkembangan Mesoderm
3. Perkembangan Sistem Urogenital
 - Sistem urinaria
 - Sistem genitalia
4. Kelainan kongenital pada sistem urogenital

Masa 3 minggu pertama

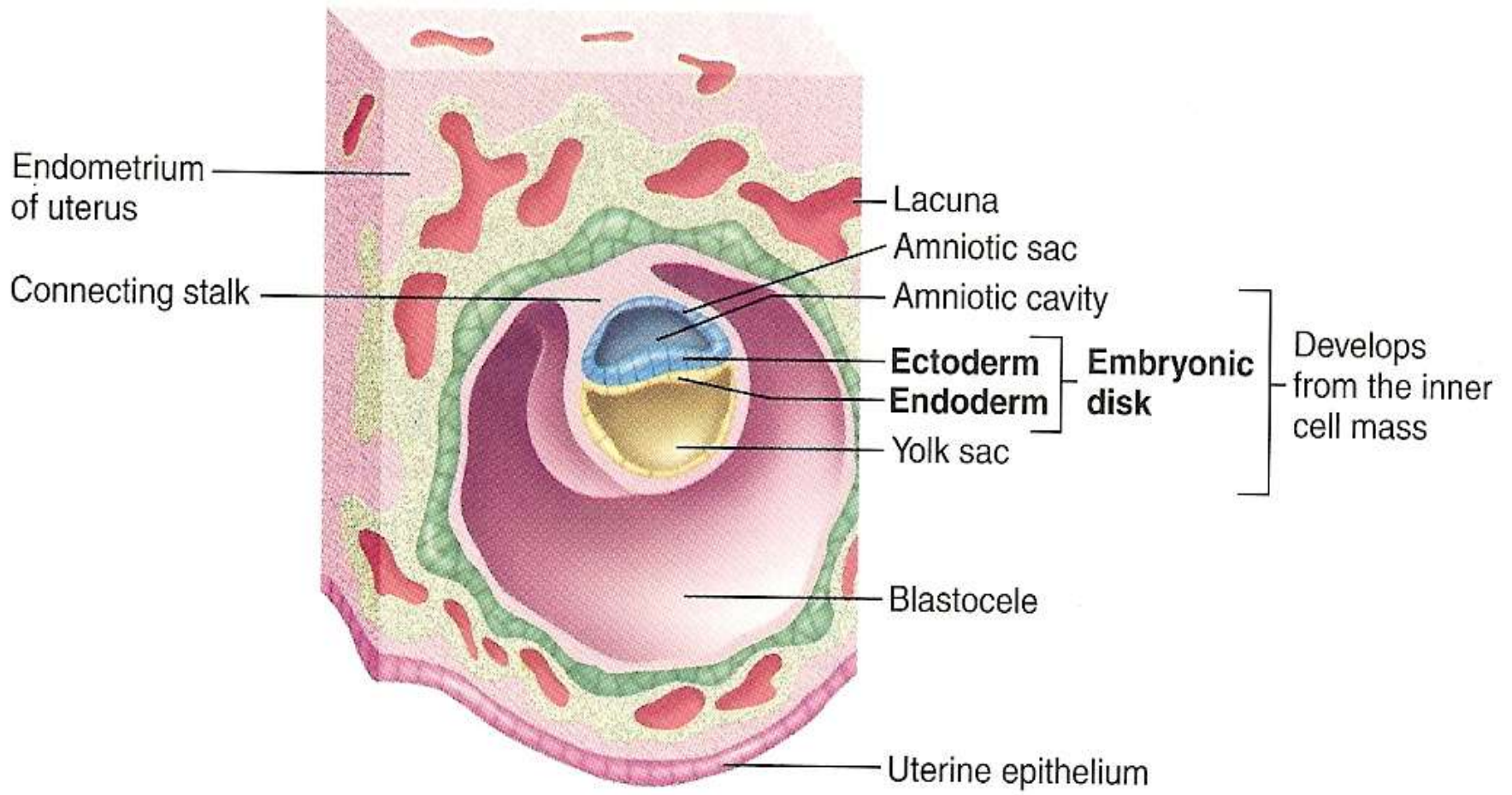
Pembentukan:

- Blastokista
- Cakram bilaminar
- Cakram trilaminar
 - Gastrulasi
 - Pelipatan badan dari lateral
 - Pelipatan kepala dan ekor

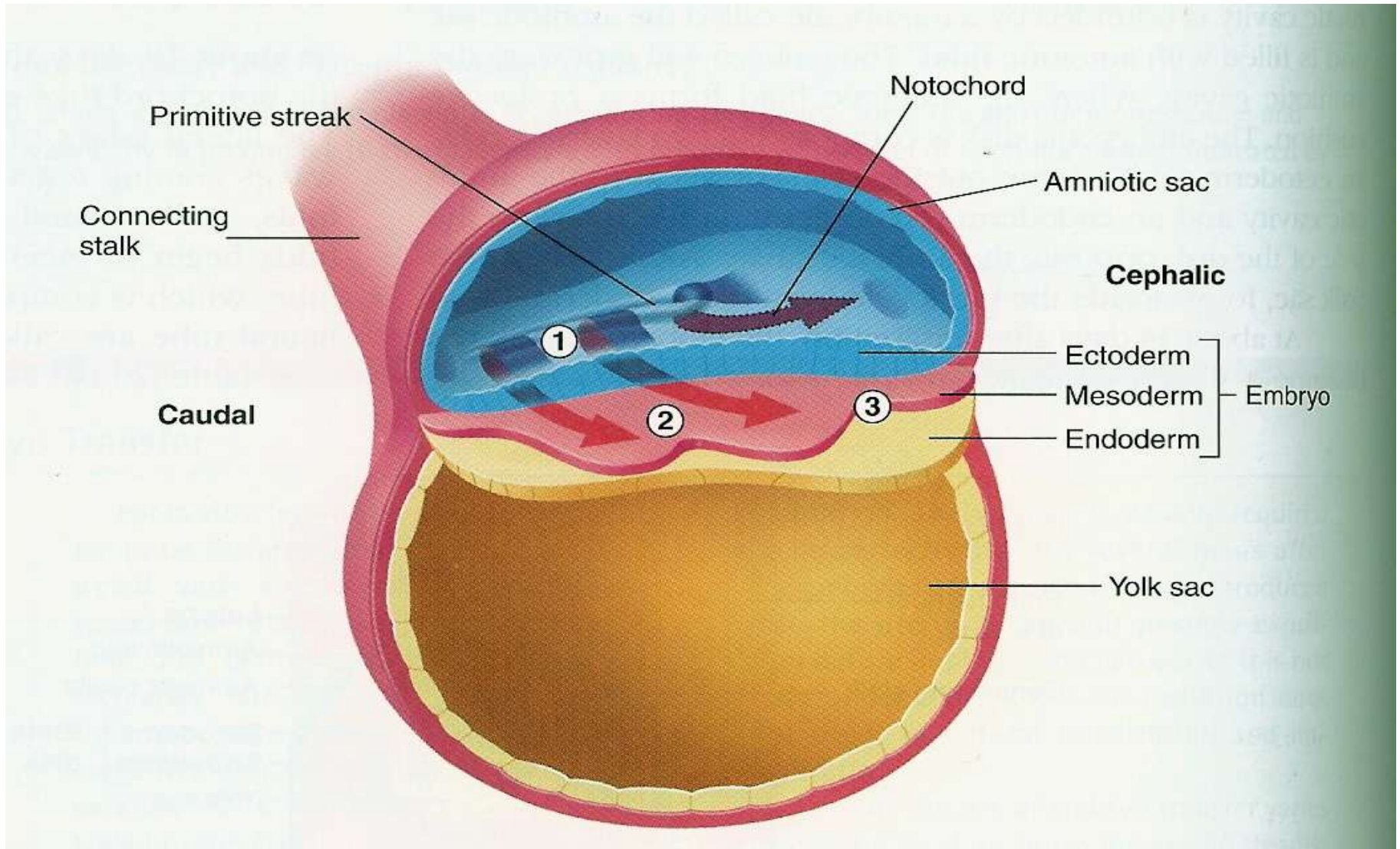
Minggu I

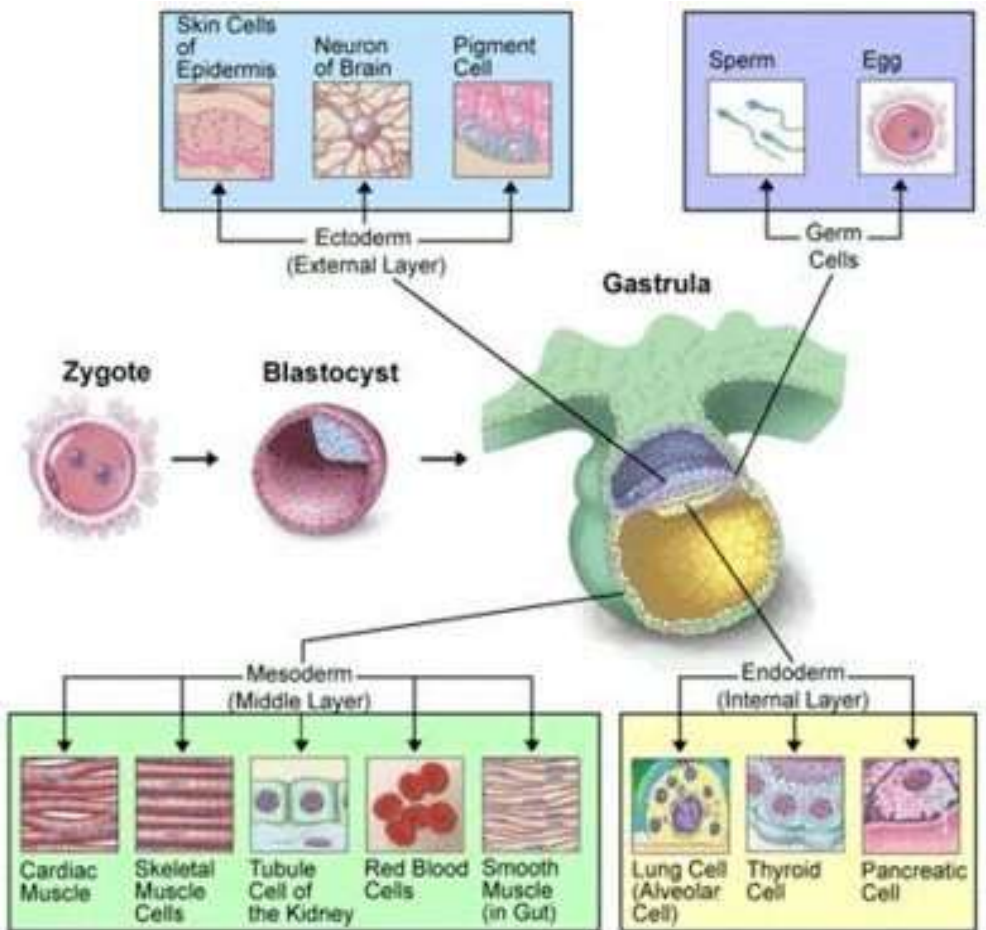
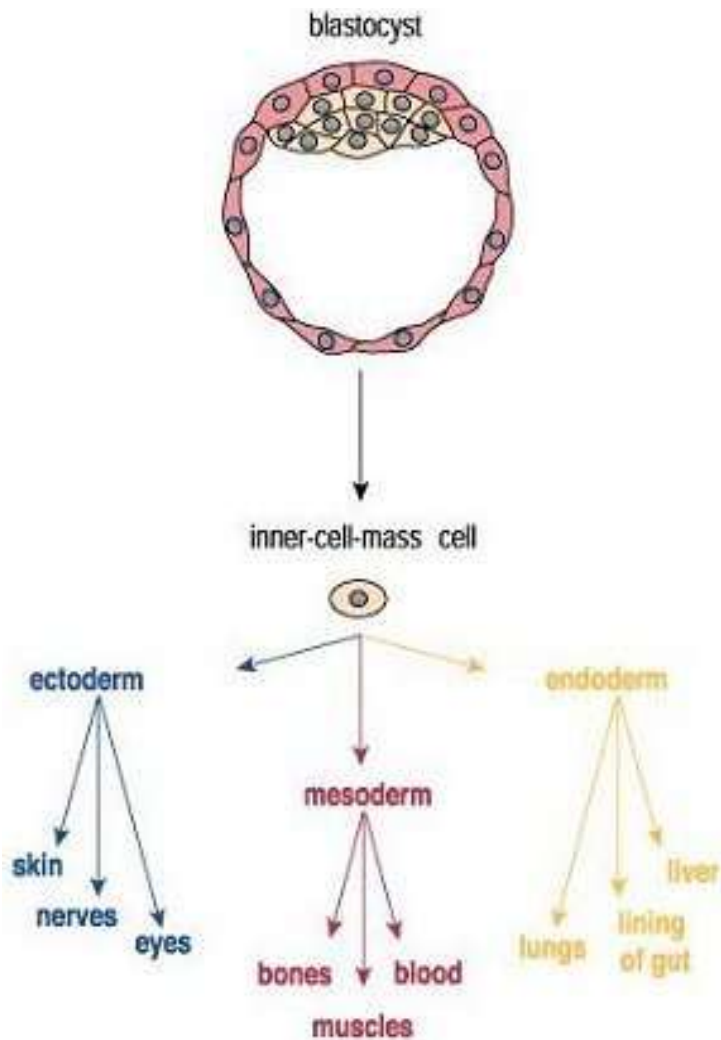


Minggu II



Minggu III

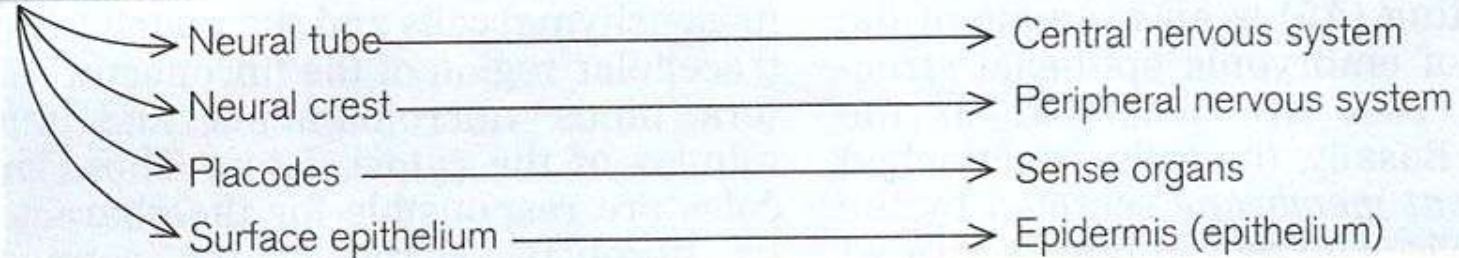




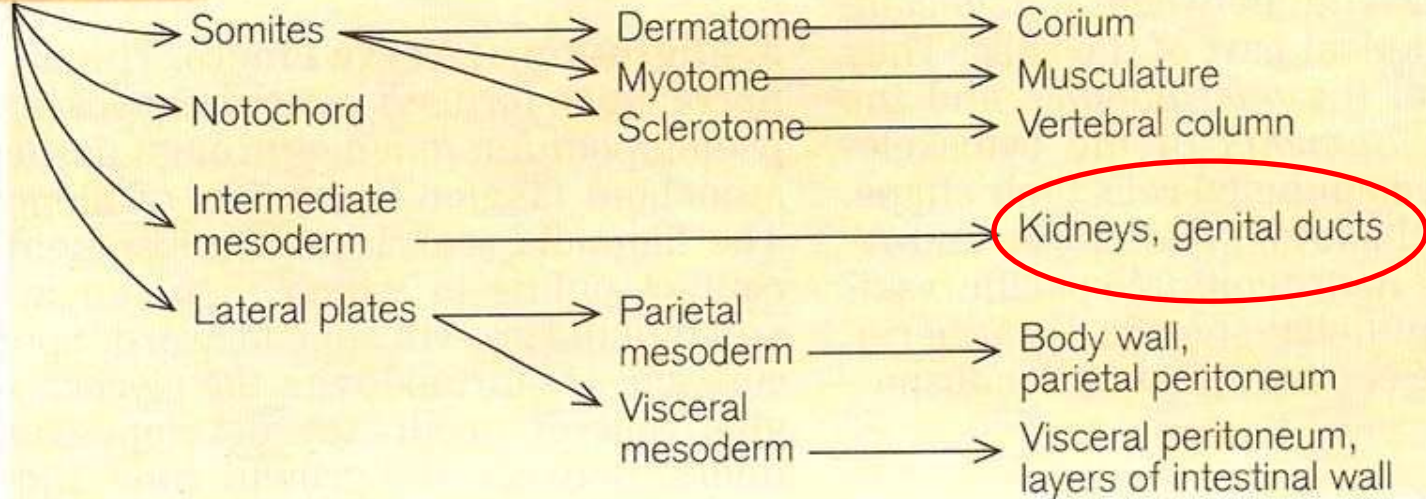
Some Embryonic Cell Types at Gastrulation

Perkembangan mesoderm intermediet

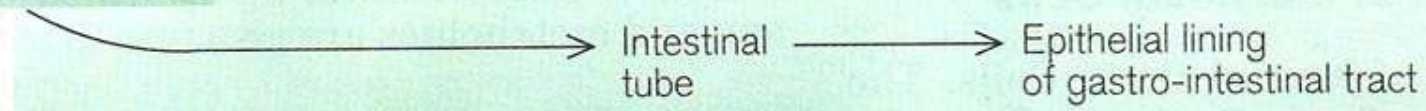
Ectoderm



Mesoderm



Endoderm



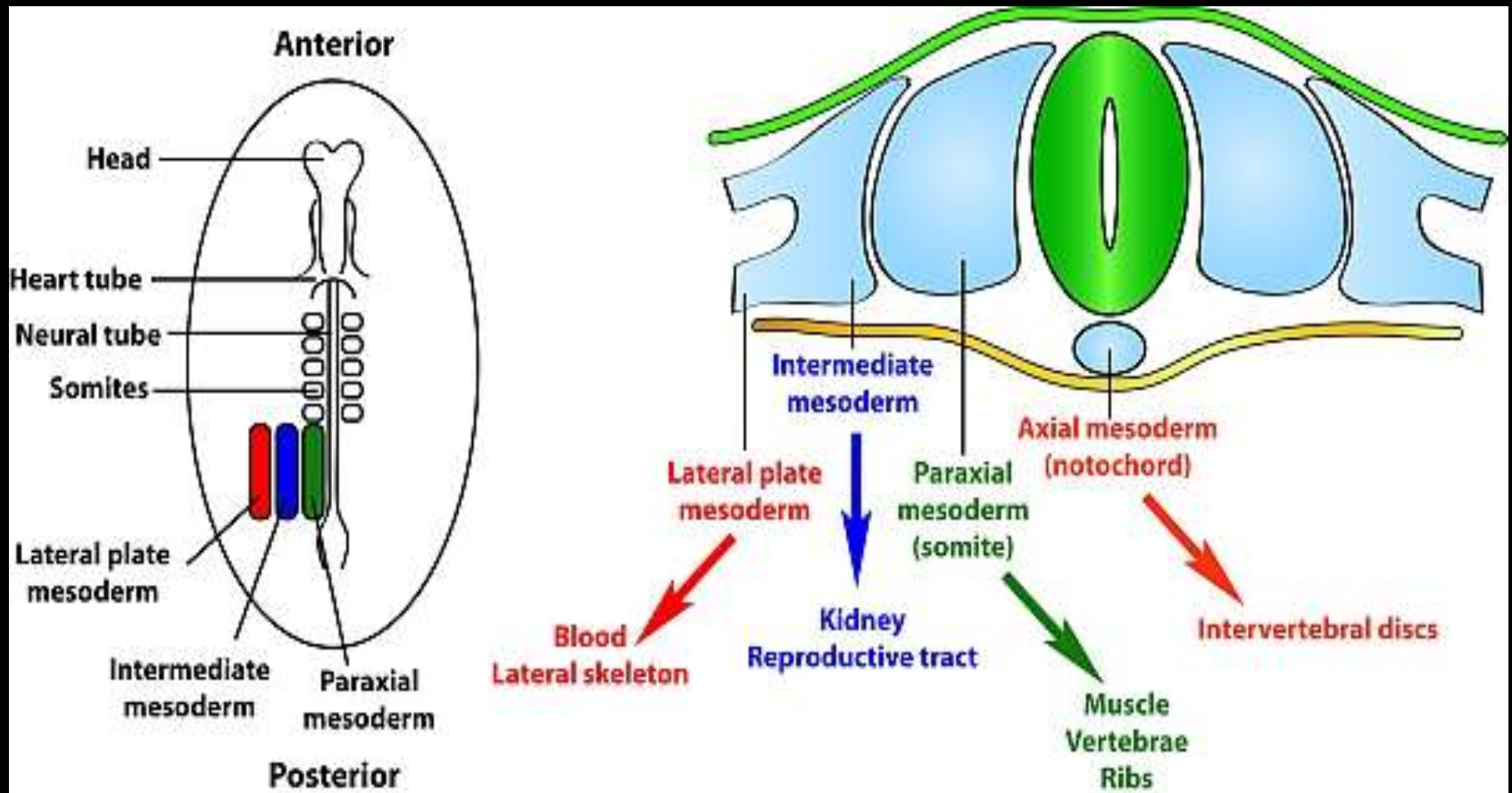
} Skin

} Gastro-intestinal canal

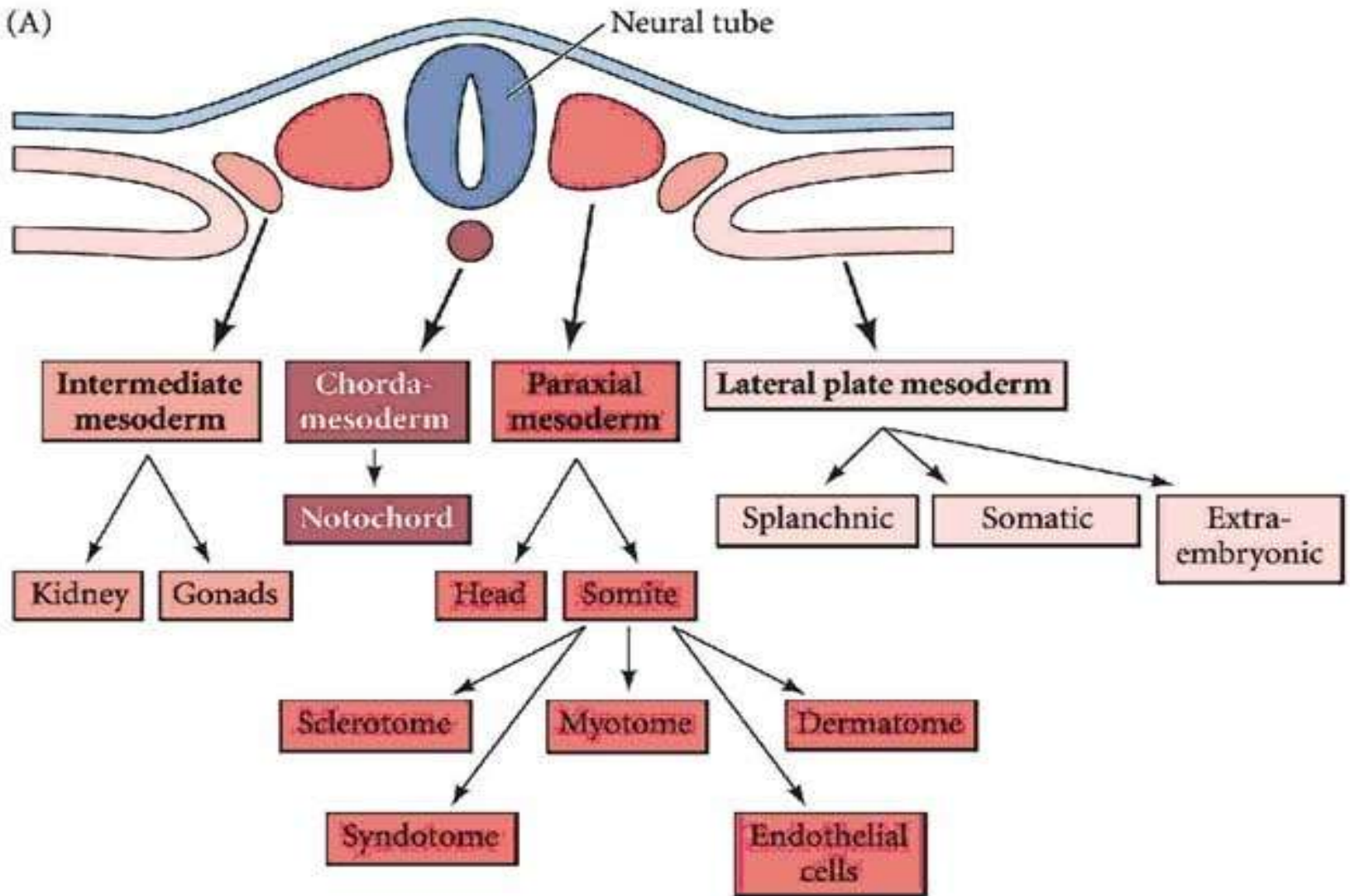
1.1 Major Cardiac Arrhythmias

	Ectoderm	Mesoderm
Lining of gastrointestinal tract	Epidermis of skin	Dermis of skin
Lining of lungs	Tooth enamel	Circulatory system
Lining of hepatic, pancreatic, and other exocrine ducts	Lens and cornea of eye	Parenchyma (substance) of glands
Kidney ducts and bladder	Outer ear	Kidneys
Anterior pituitary	Nasal cavity	Gonads
Thymus gland	Neuroectoderm	Muscle
Thyroid gland	Brain and spinal cord	Bones (except facial)
Parathyroid gland	Somatic motor neurons	
Tonsils	Preganglionic autonomic neurons	
	Neural crest cells	
	Melanocytes	
	Sensory neurons	
	Postganglionic autonomic neurons	
	Adrenal medulla	
	Facial bones	
	Teeth: dentin and pulp	

Perkembangan Mesoderm



(A)



Perkembangan Sistem Urogenital

- Dimulai pada minggu ke-4
- Sistem Fisiologis : *Sistem Urinaria* dan *Sistem Genital*
- Secara embriologis sama-sama berasal dari **mesoderm intermediate** dan bermuara **di kloaka**
- Terletak di sepanjang dinding belakang rongga perut

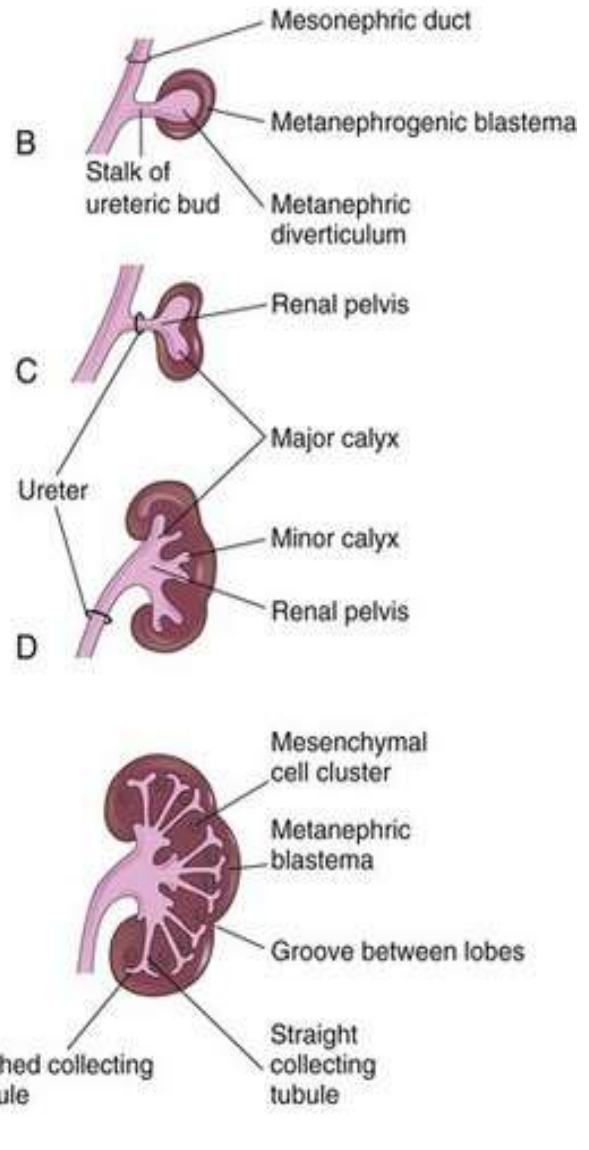
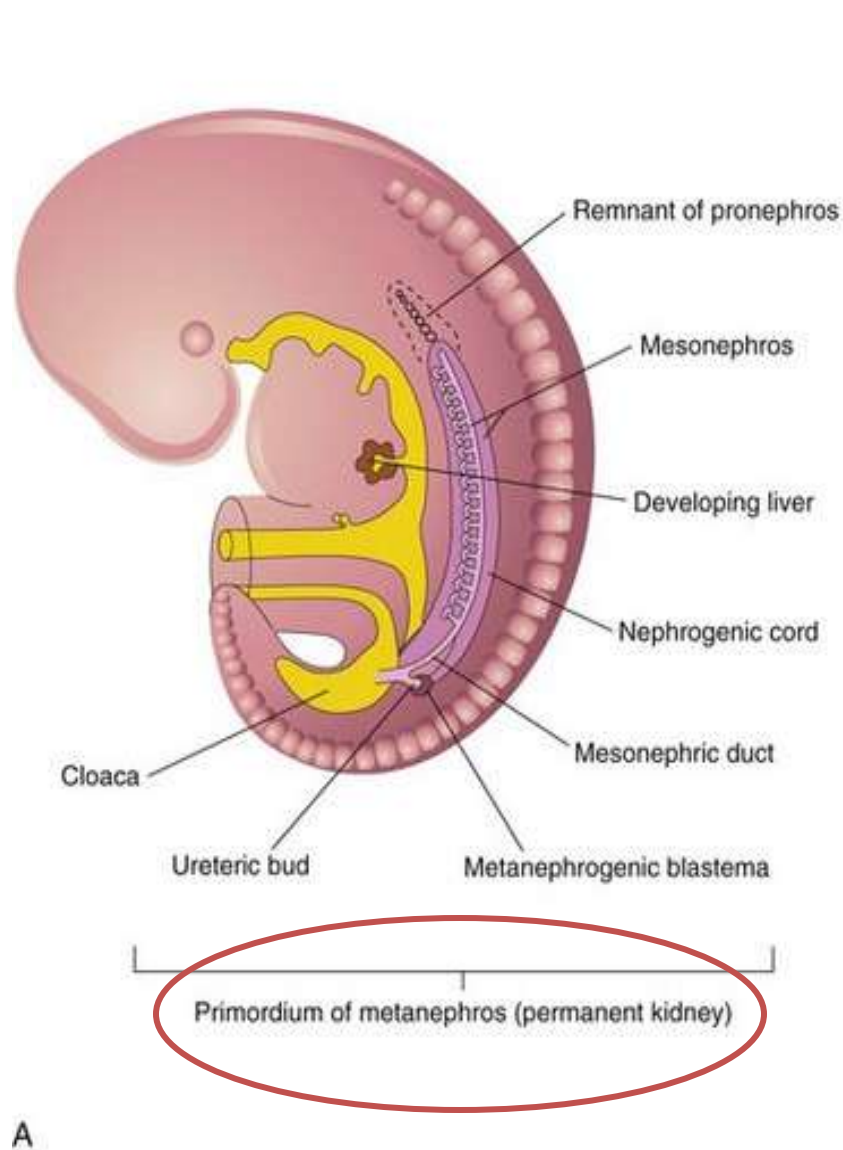
Urinary system

- 3 sistem ginjal → pronefros, mesonefros, **metanefros**
- Metanefros mulai nampak pada minggu ke-5
- **Ginjal berkembang dari 2 sumber:**
 - **mesoderm metanefros → membentuk satuan ekskresi** (glomerulus dan simpai bowman)
 - **tunas ureter → membentuk satuan pengumpul**
(tunas ureter membentuk tubulus contortus proximal, ansa henle dan distal, system calyx, pyelum dan ureter)

▪
▪

-
- ☀️ PRONEFROS → rudimenter
 - ☀️ MESONEFROS → awal fetus
 - ☀️ METANEFROS → ginjal tetap

Development of kidney



Susunan Pengumpul

Tunas ureter (suatu penunjolan Saluran mesonefros dekat Muara ke dalam Kloaka)

Menembus jaringan metanefros

Piala ginjal sederhana

Calix mayor

Calix minor

Tunas ureter

Mesoderm metanefros

Susunan Ekskresi

Nefron (ujung proksimal)

Simpai bowman

Tubulus contortus proksimal

Jerat henle

Tubulus contortus distal

Ujung distal

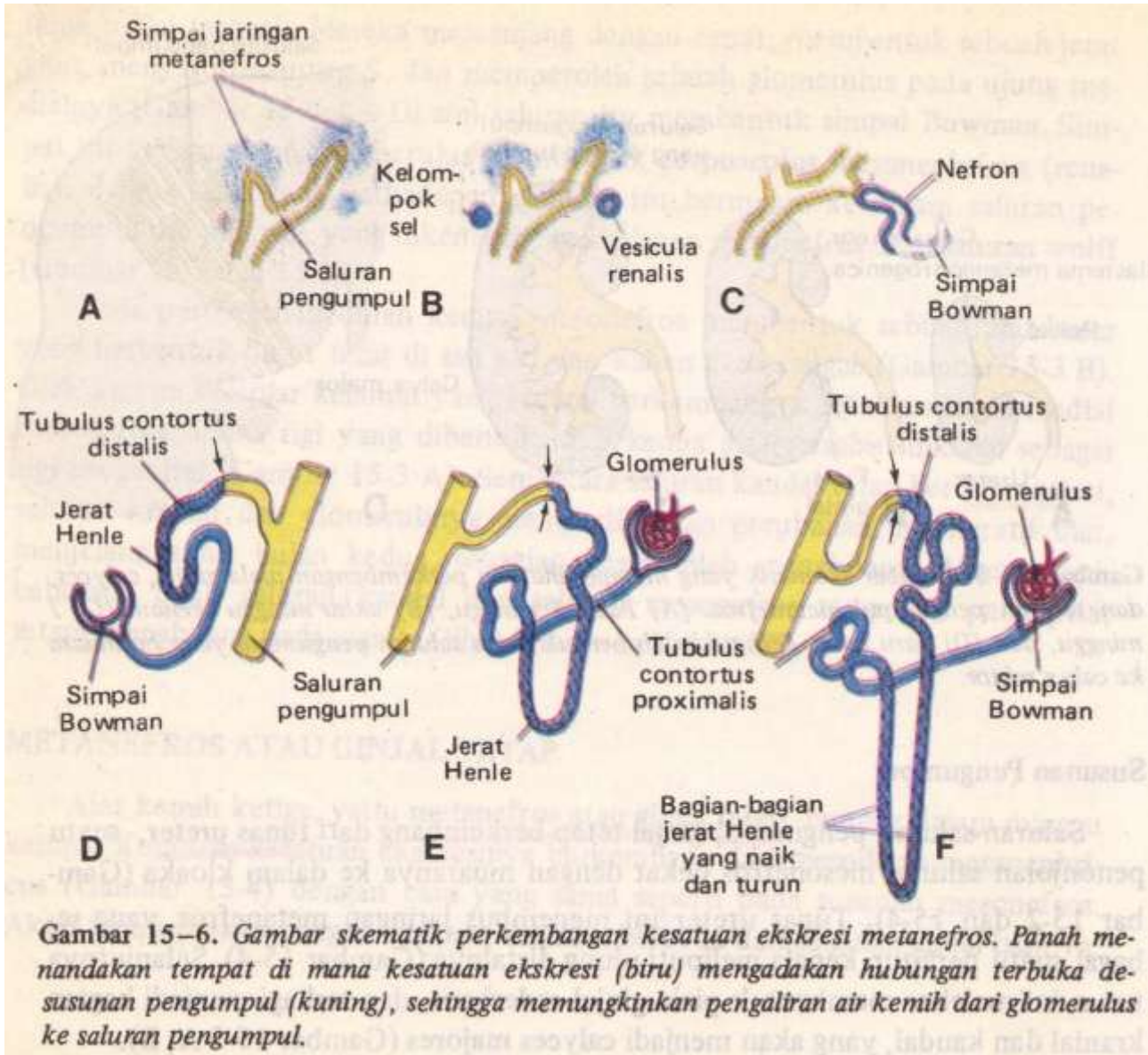
Membentuk hubungan Terbuka dengan

Saluran pengumpul

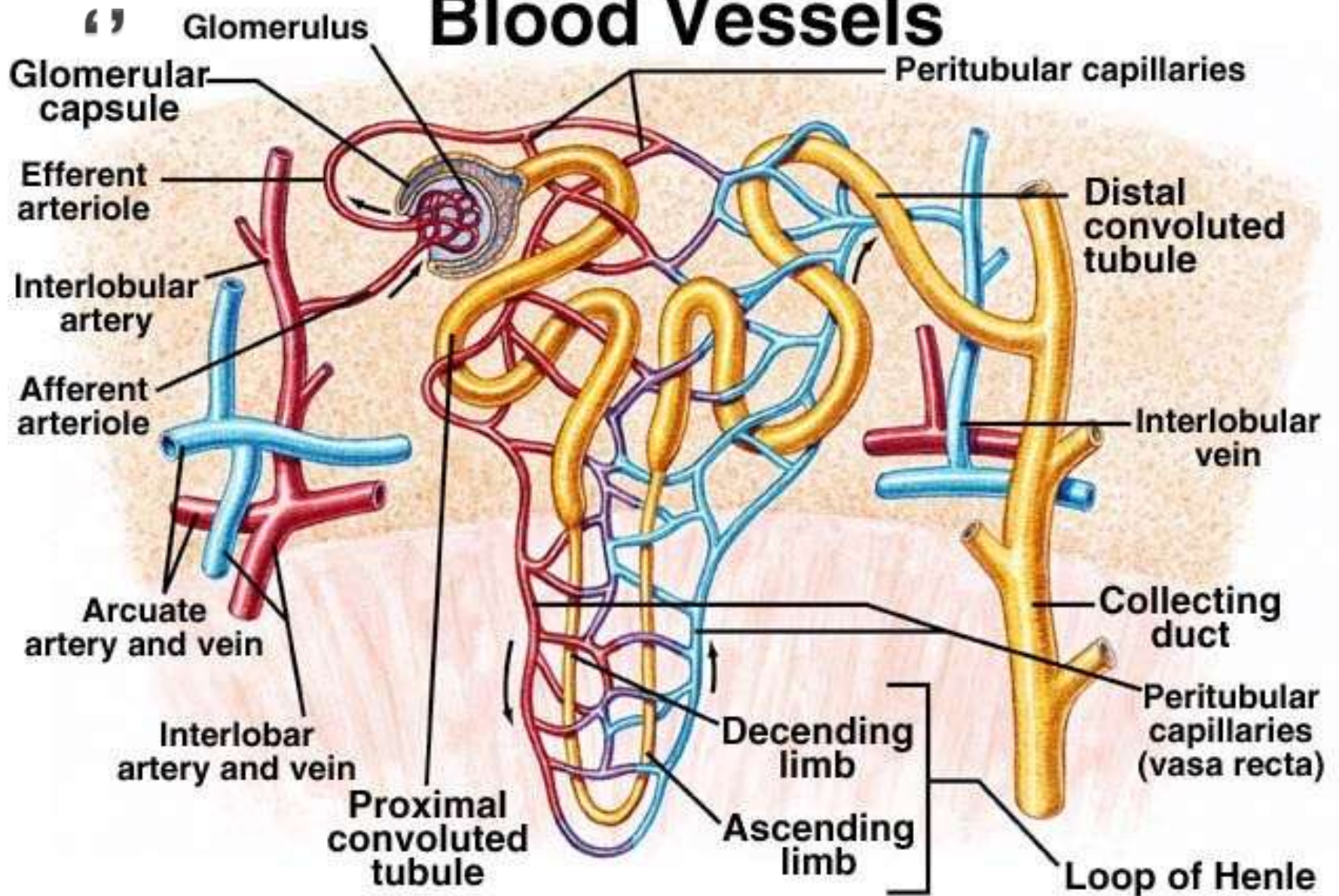
Ginjal

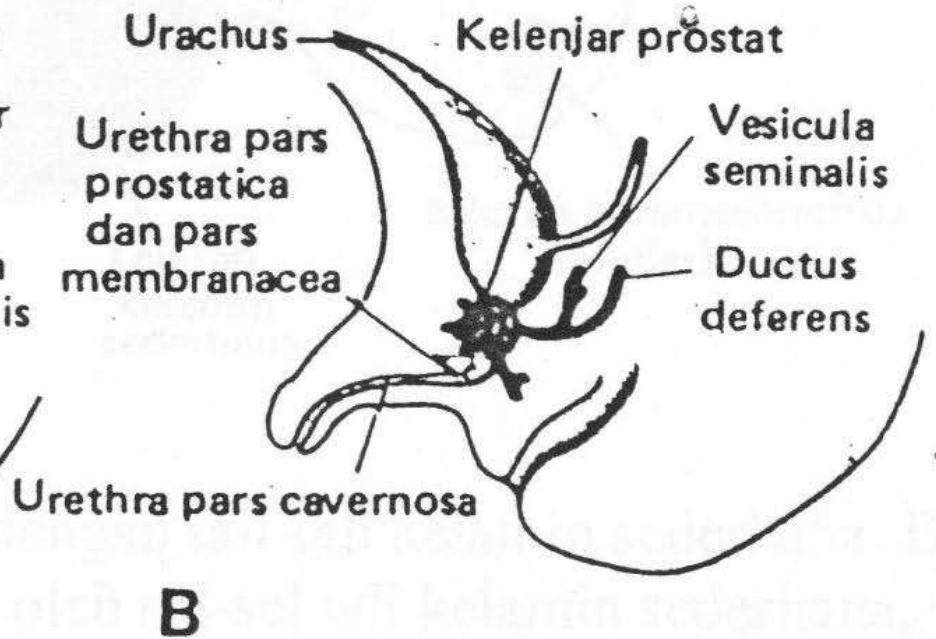
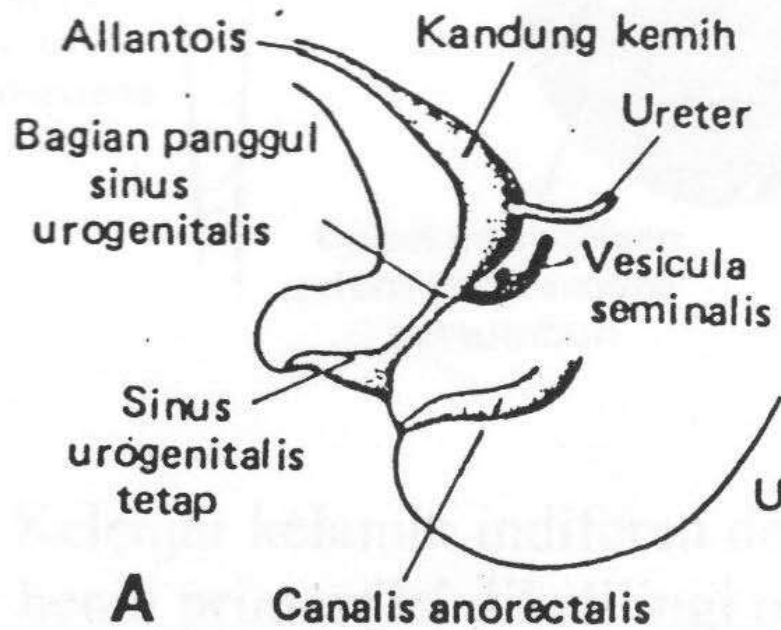
METANEFROS:

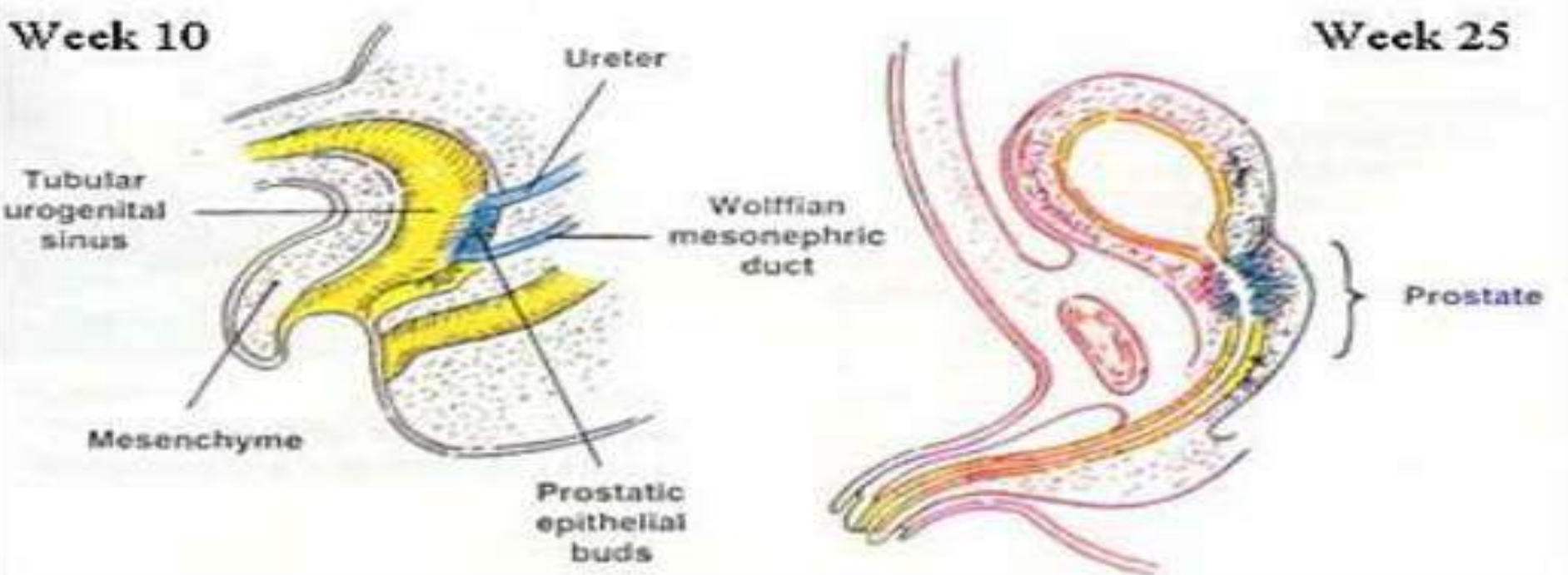
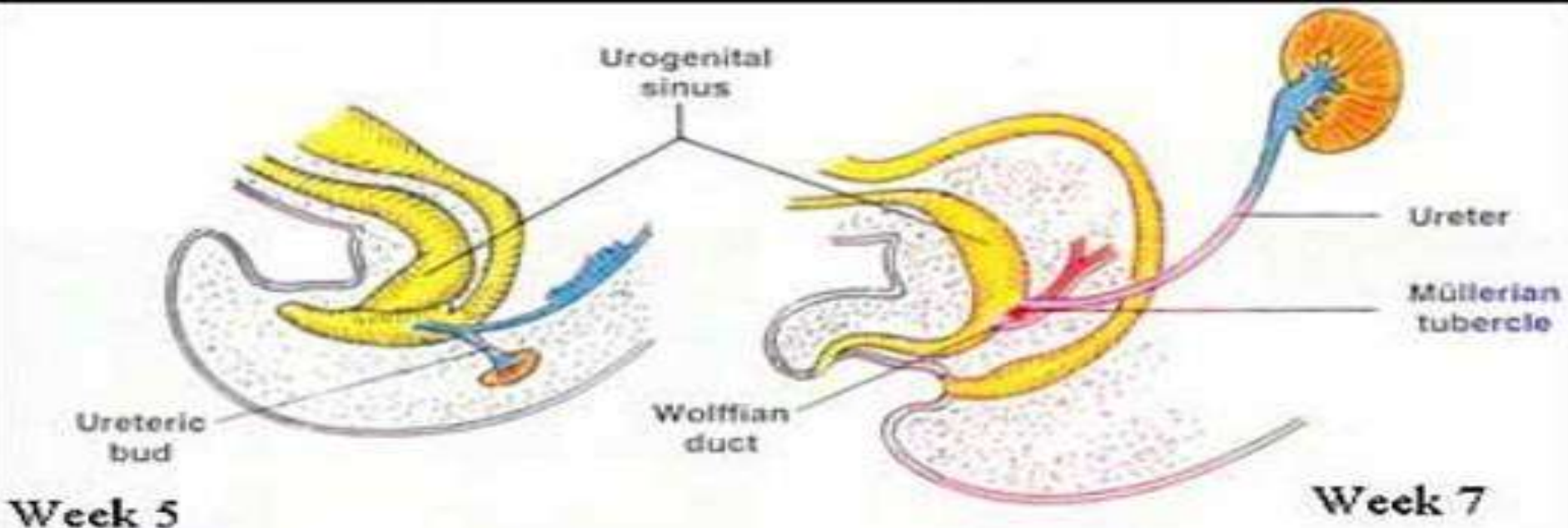
SUSUNAN EKSKRESI & SALURAN PENGUMPUL



Nephron Tubules and Associated Blood Vessels



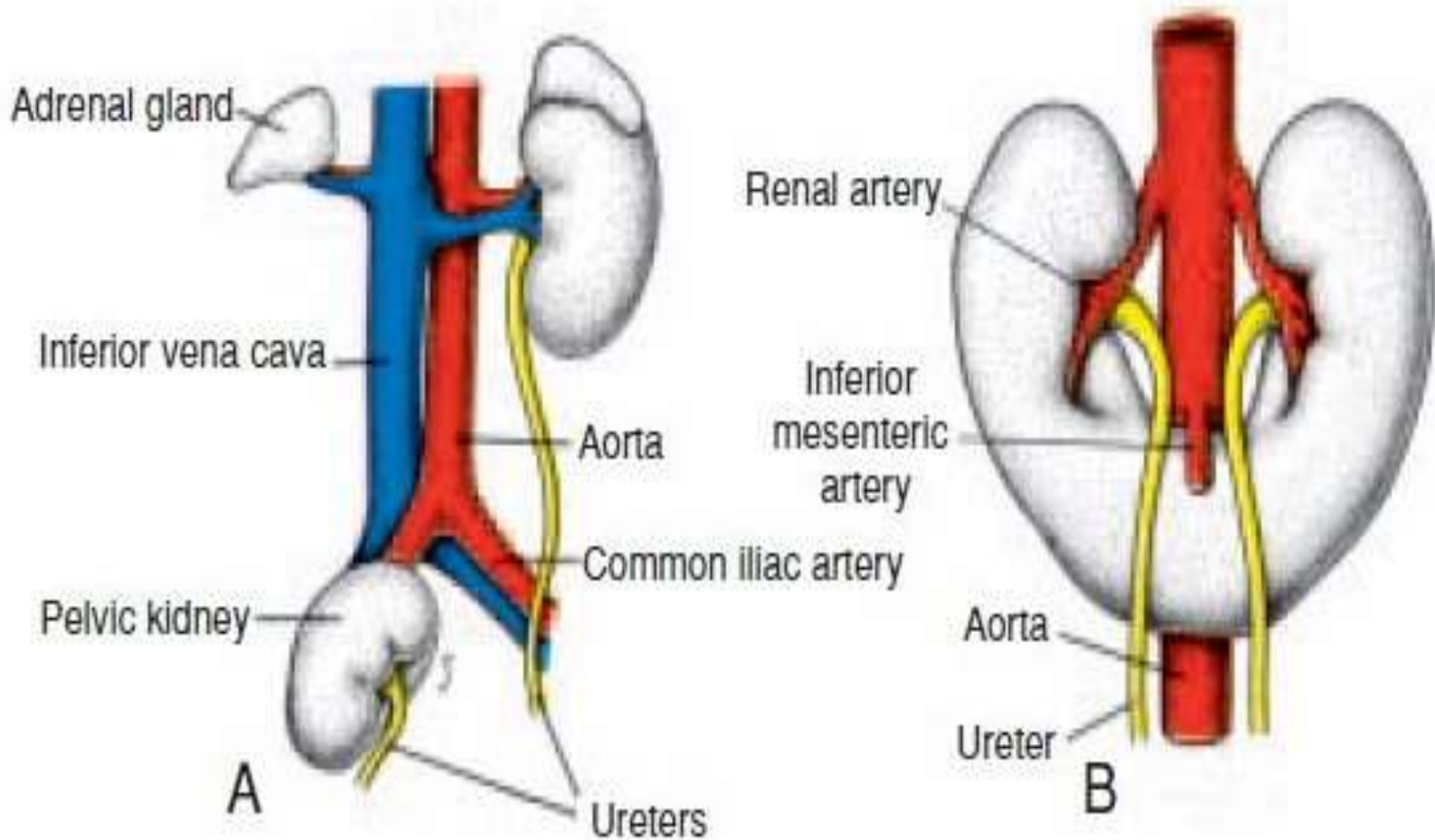




Clinical features

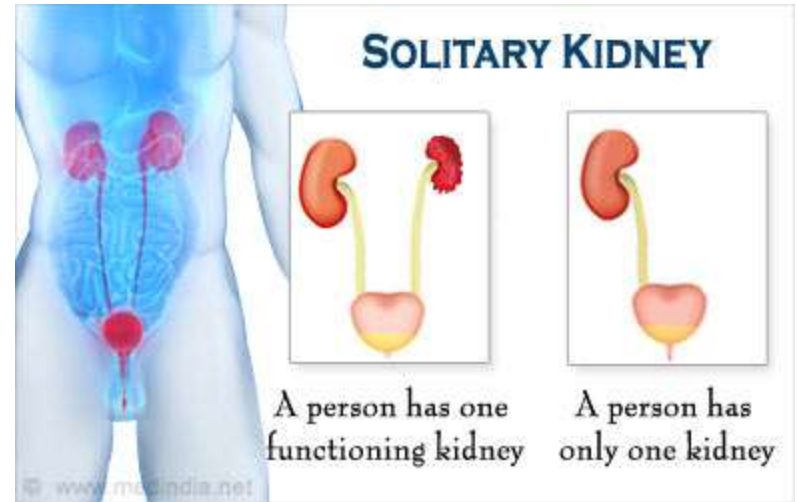
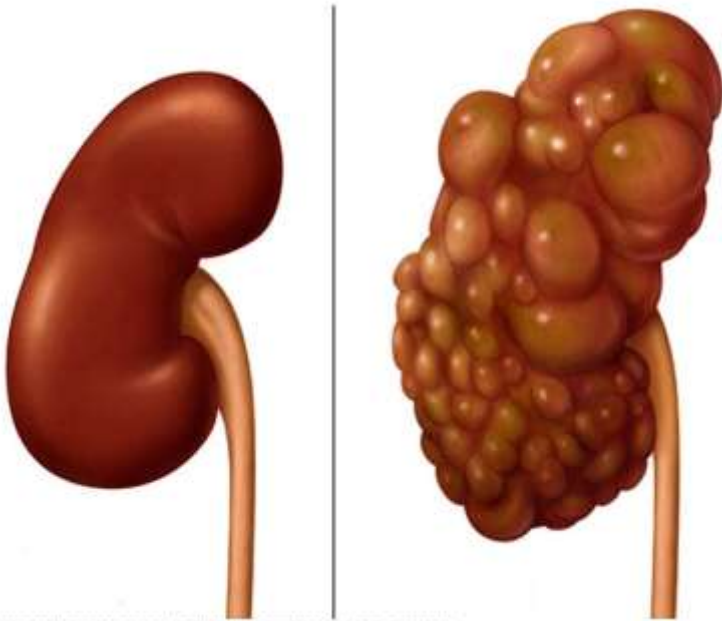
- Polycystic kidney (karena kelainan tubulus proksimal)
- Unilateral or bilateral agenesis of the kidney (karena degenerasi dini tunas ureter)
- Ureter duplication (karena pembelahan dini tunas ureter)
- Pelvis kidney (gagalnya ginjal bermigrasi dari panggul ke rongga perut)
- Horseshoe kidney (pertumbuhan kedua ginjal yang terlampau dekat → menyatu di polus posterior)
- A renalis asesorius (menetapnya pembuluh darah embrional)

Pelvic kidney & horseshoe kidney



Polycystic kidney

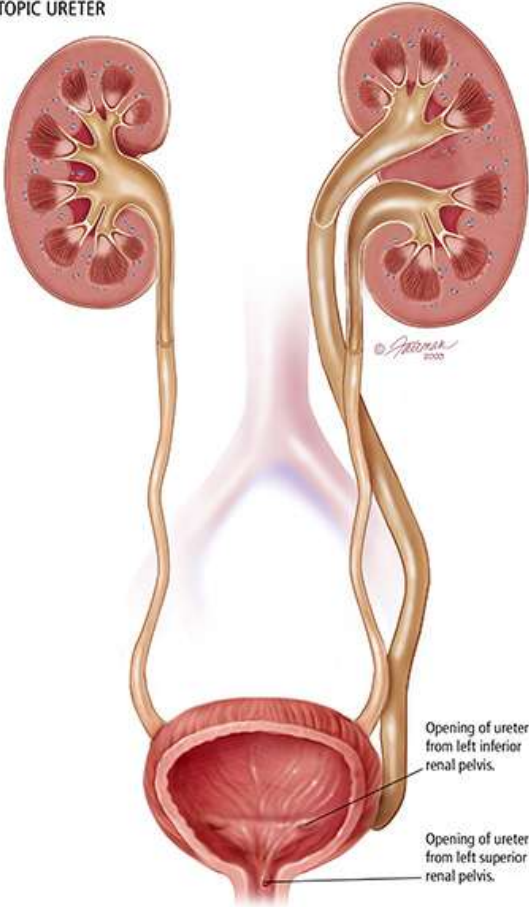
renal agenesis



Ureter duplication

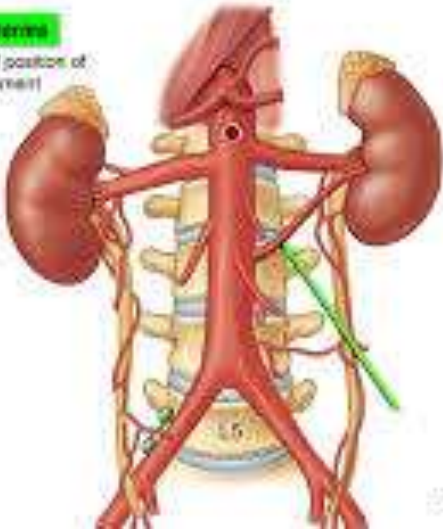
a. renalis accesorius

ECTOPIC URETER



Kidneys, ureters, suprarenal glands

Accessory renal arteries
(Remnant of change of position of kidneys during development)



Case courtesy of Dr Roberto Schuber, Radiopaedia.org, ID: 17245

Vesica Urinaria dan Uretra

Kloaka akan terbagi oleh **septum urorectal** menjadi **sinus urogenital** dan **canalis analis (minggu ke 4-7)**

Sinus urogenital terbagi menjadi 3:

1. bag. Teratas (*vesical part*) → **v.u**
2. bag. Tengah(*pelvical part*) → **uretra pars prostatica dan membranacea**
3. bag bawah (*phallus part*) → **uretra pars spongiosa**

Ductus ejaculatorius terbentuk dari ductus mesonefros yang masuk ke uretra pars prostatica

Prostat terbentuk dari tonjol dari uretra pars prostatica yang menembus jar. Mesenkim di sekitarnya

Cloaca division

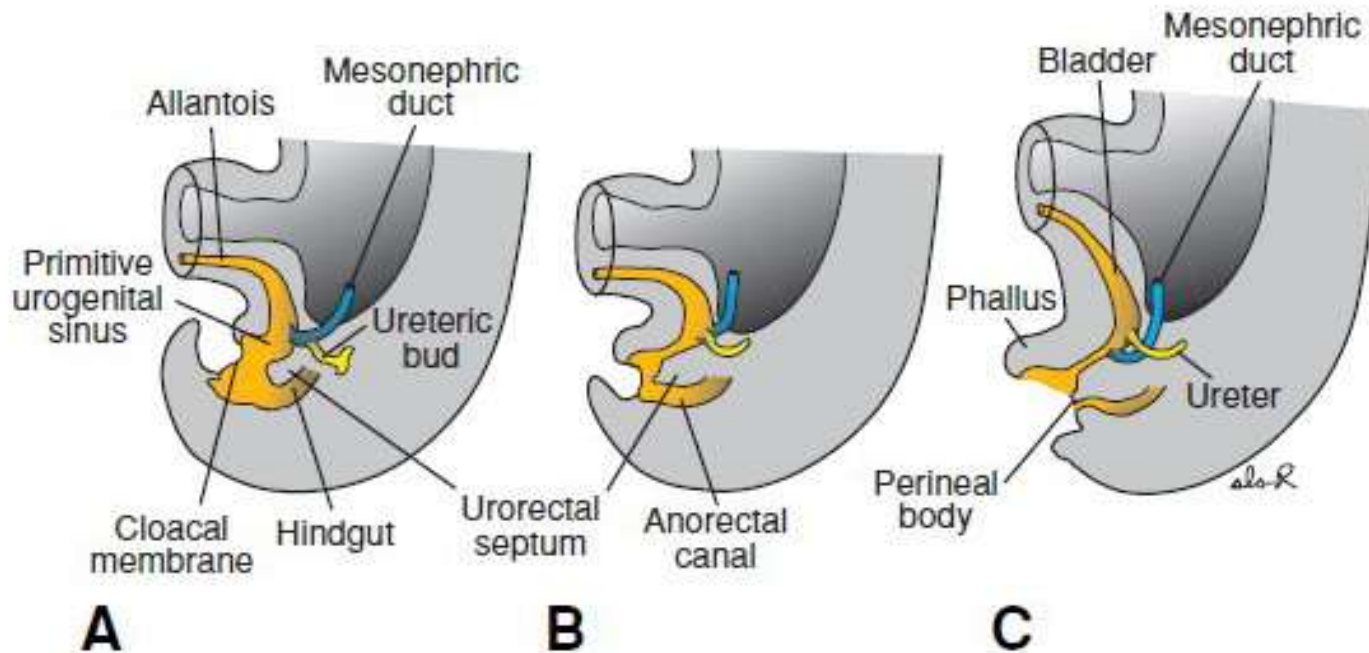
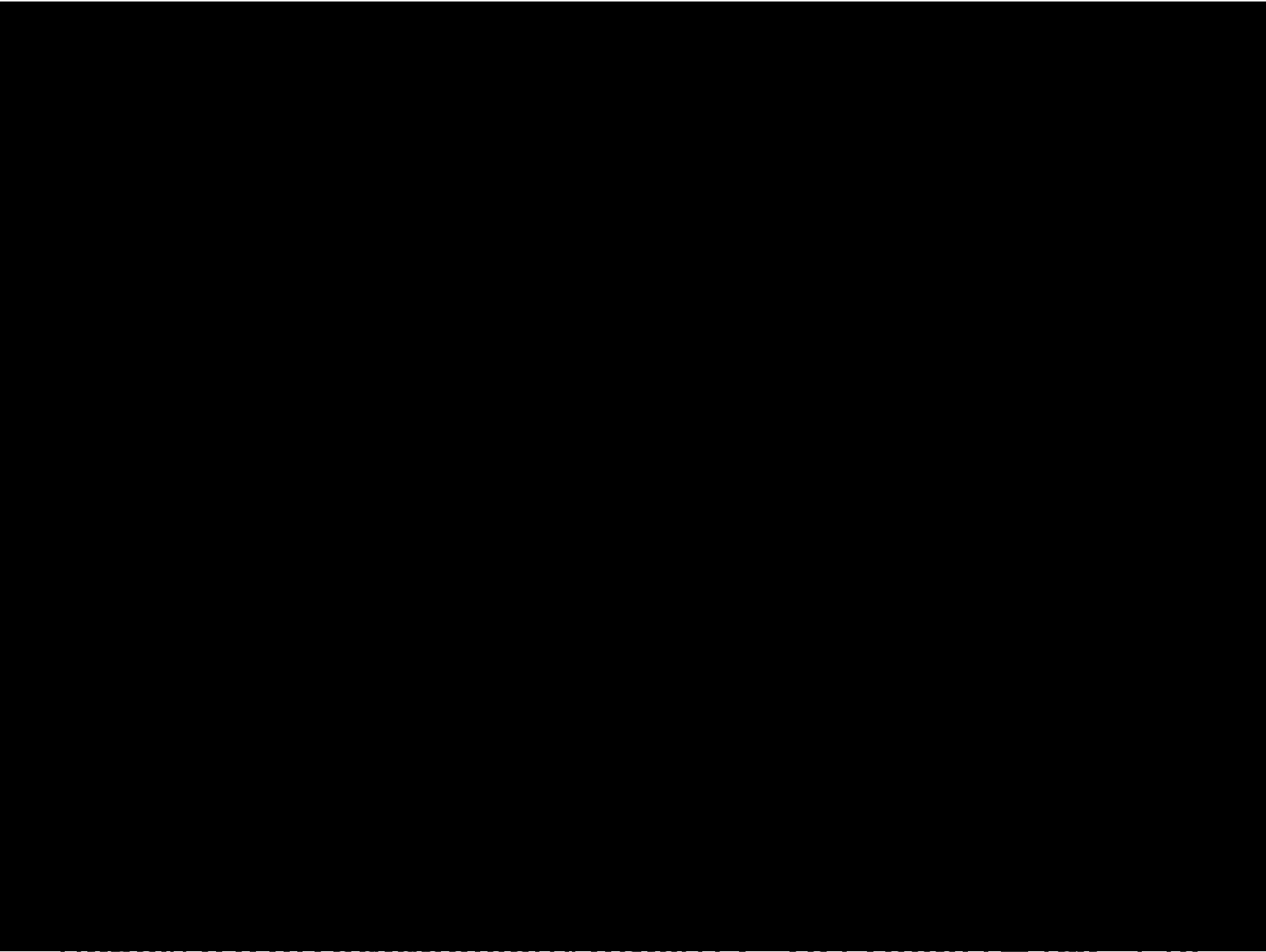


Figure 14.12 Divisions of the cloaca into the urogenital sinus and anorectal canal. The mesonephric duct is gradually absorbed into the wall of the urogenital sinus, and the ureters enter separately. **A.** At the end of the fifth week. **B.** 7 weeks. **C.** 8 weeks.



Importantly, consideration of materiality to the region is not the

S

Clinical features

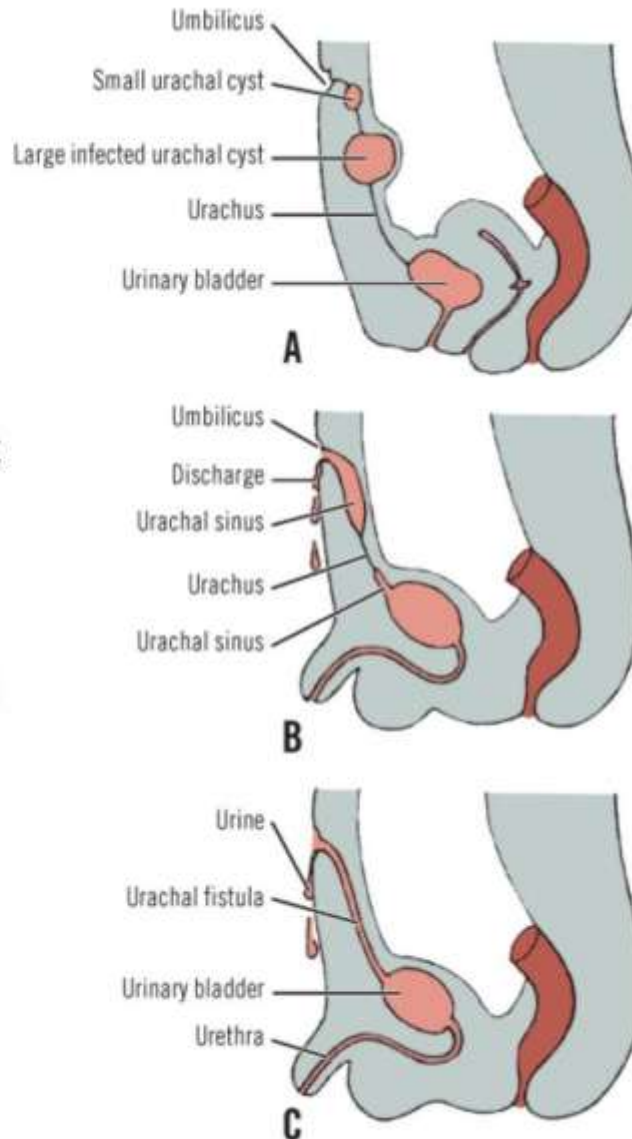
- Bladder exstrophy
- Urachal fistula
- Cloaca exstrophy

Urachal anomalies

A, Urachal cyst, persistence or remnant of epithelial lining of urachus.

B, Urachal sinus, discharge serous fluid from the umbilicus.

C, Urachal fistula, the entire urachus remains patent and allows urine to escape from the umbilicus.



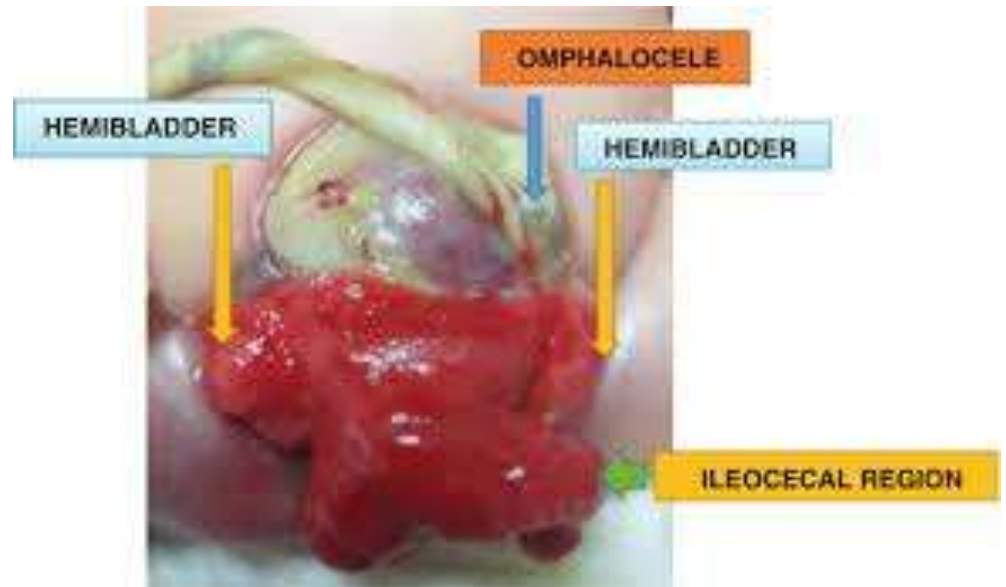
Bladder Exstrophy

- This male infant was born with bladder exstrophy.
- The bladder mucosa is everted and lies on the abdomen. Both ureteric orifices lie on the exstrophic bladder.
- Notice that the penis is shortened and that there is no urethral meatus.
- His urethra is actually a plate of deep red mucosa lying on the dorsal penis. This is called **epispadias**.



Cloacal Exstrophy

- Vesica urinaria terbagi menjadi 2 hemibladder
- Colon proximal buntu
- Dinding abdomen superior mengalami hypoplasia atau agenesis



Genital system

Terdiri dari :

1. gonad primitif,
2. ductus genitalis
3. genetalia eksterna

→ Awalnya indiferen

→ sel benih primordial menjadi pemicu berkembangnya kelenjar kelamin: ovarium / testis

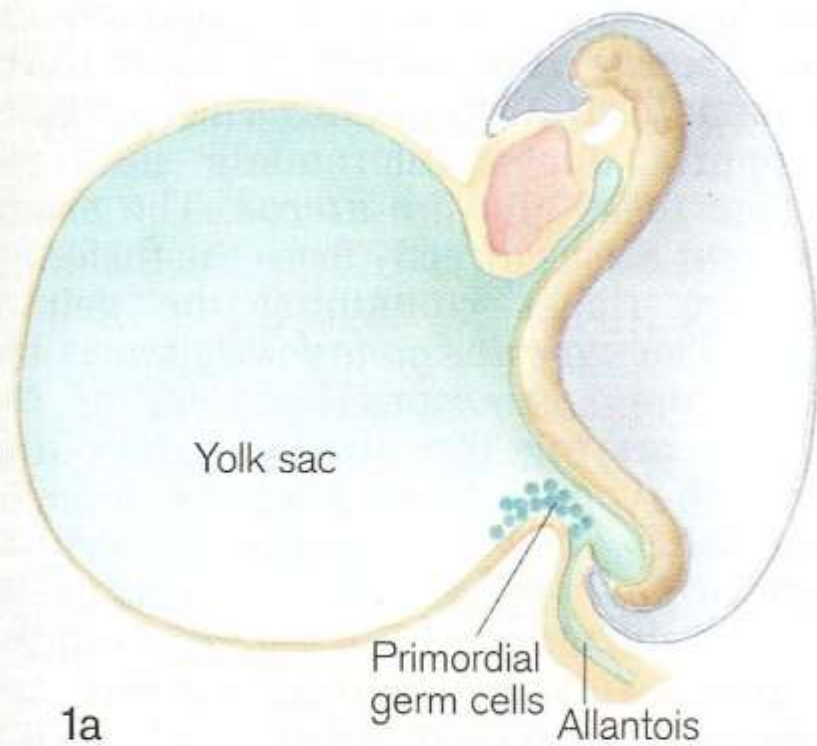
1. Gonad Primitif

Gonad primitif bermula dari **rigi gonadal**

Germ cell primordial tampak mula2 di sekitar endoderm di dinding yolk sac → bermigrasi sepanjang mesenterium dorsal → gonad primitif

Testis berkembang di bawah pengaruh **testosteron**

Korda genital primitif berproliferasi → menembus medulla → testis & korda medullaris → membentuk saluran2 yg berkembang mnjadi rete testis → terpisah oleh tunica albugenia

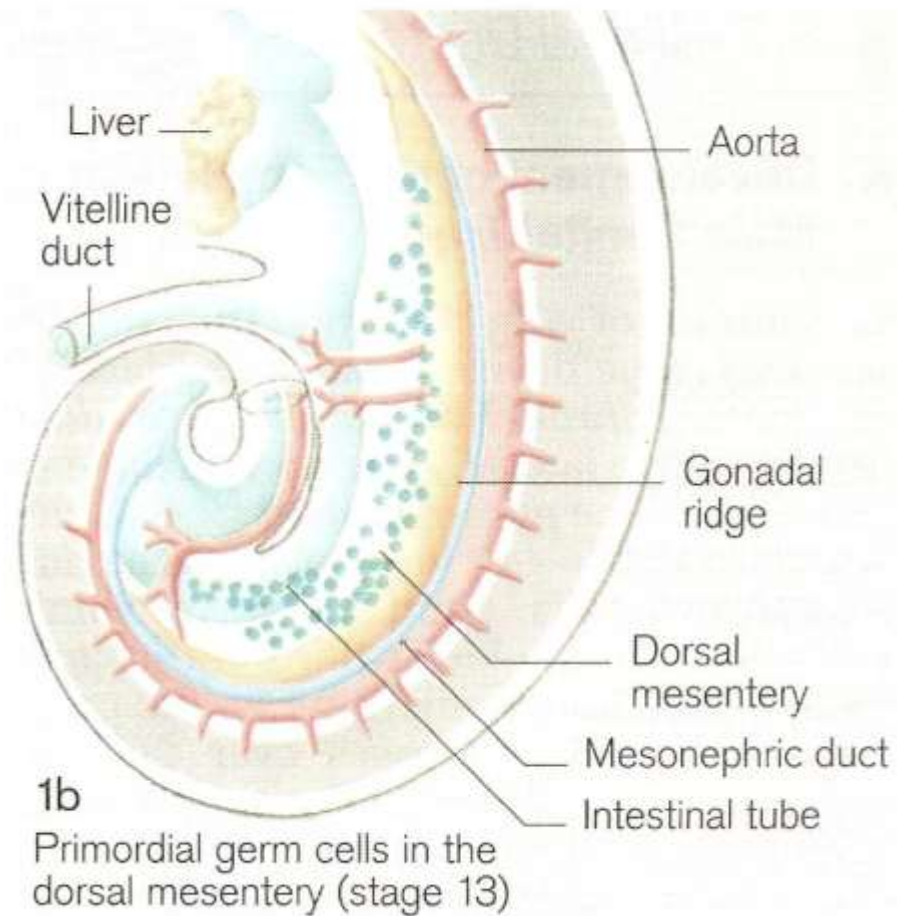


1a

Primordial germ cells in the yolk sac (stage 12)

1

Migration of primordial germ cells



1b

Primordial germ cells in the dorsal mesentery (stage 13)

Sel-sel benih primordial dinding kandung kuning telur. Sel-sel benih primordial bermigrasi sepanjang dinding usus sederhana belakang dan mesenterium dorsal ke dalam rigi kelamin.

Korda testis membentuk tubulus seminiferus →
bergabung membentuk ductus efferen → rete
testis → bergabung dengan saluran dari ductus
wolfii/mesonefros → ductus defferen

DEFERENSIASI KELAMIN (Laki-laki)

Corda KELAMIN INDIFEREN



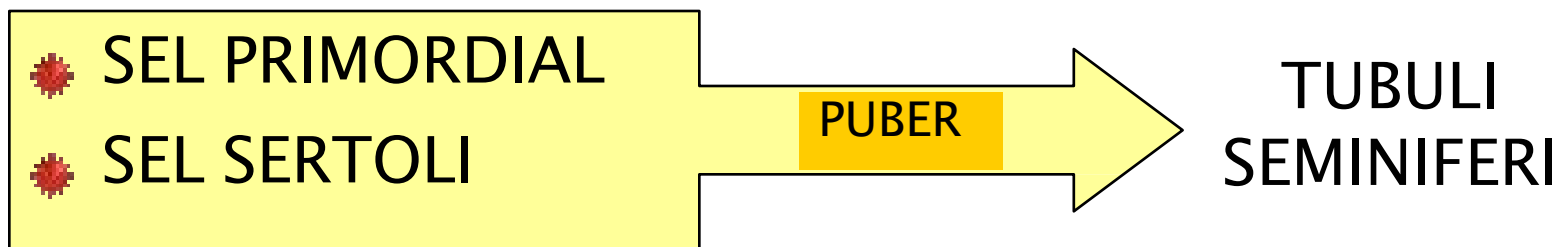
Corda TESTIS



RETE TESTIS

rete testis dipisahkan
dari epitel permukaan
oleh tunika albuginea

TALI TESTIS:



TUBULI SEMINIFERI



RETE TESTIS



DUCTULI EFERENTES



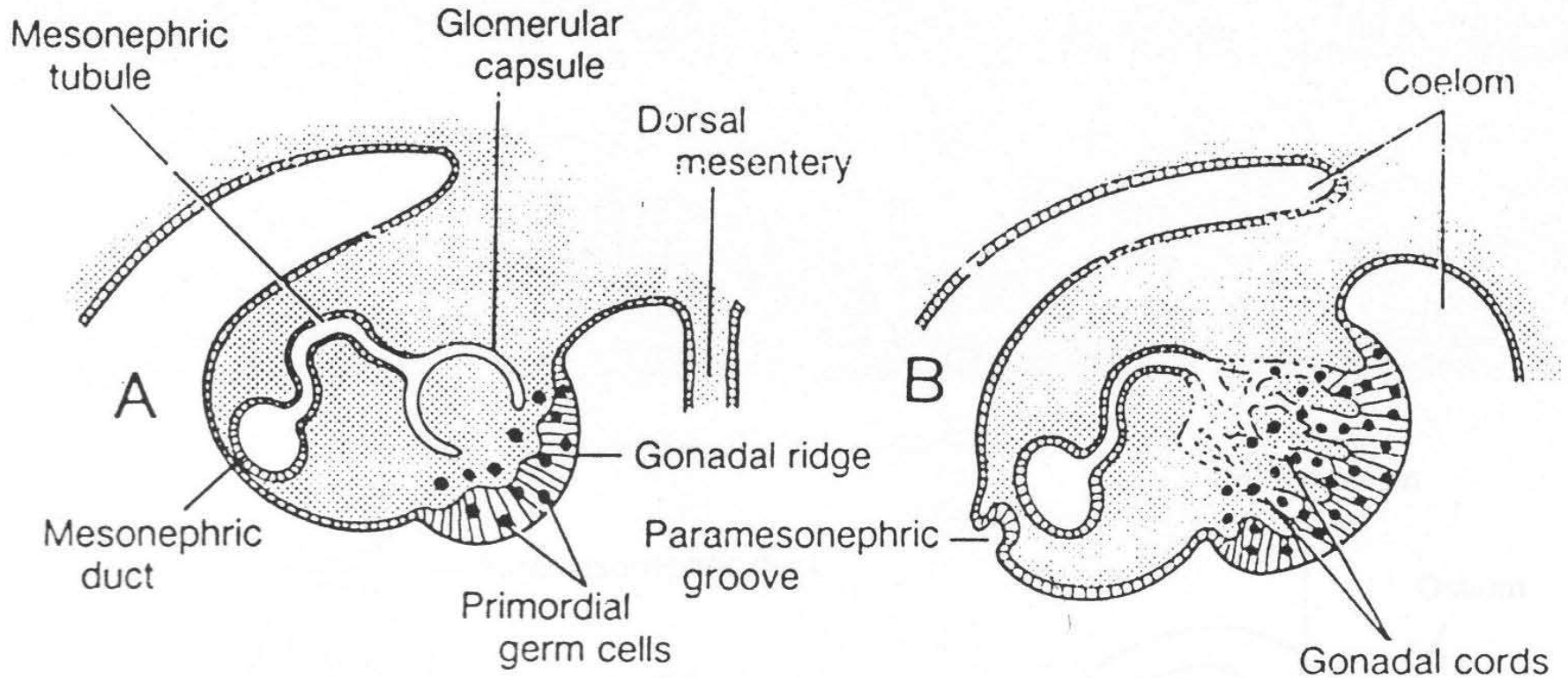
SALURAN WOLFF



DUCTUS DEFERENS

SEL LEYDIG BERKEMBANG DARI MESENKIM

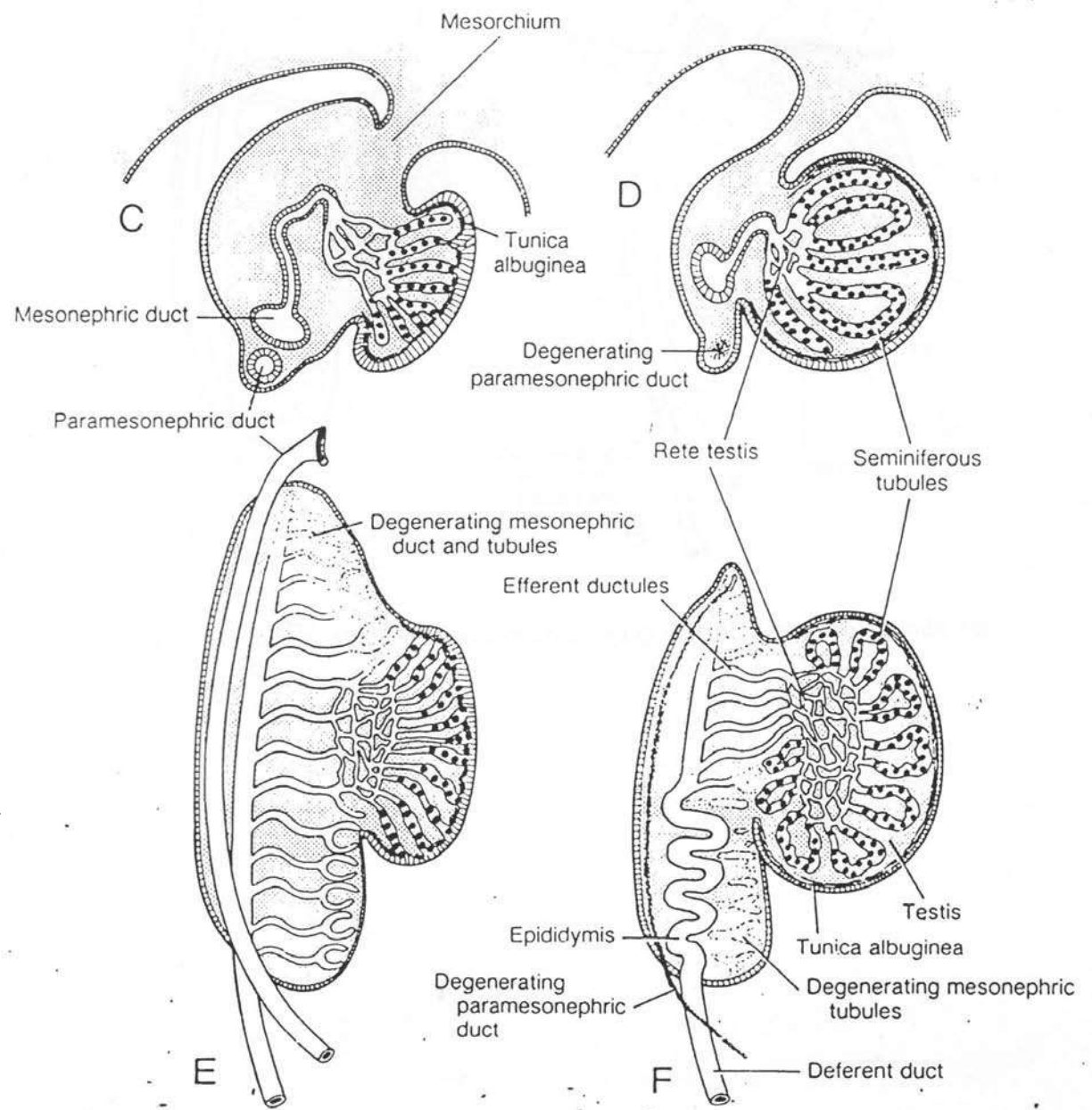
LAKI- LAKI:



TAHAP INDIFEREN

LAKI-LAKI:

TAHAP DIFERENSIASI

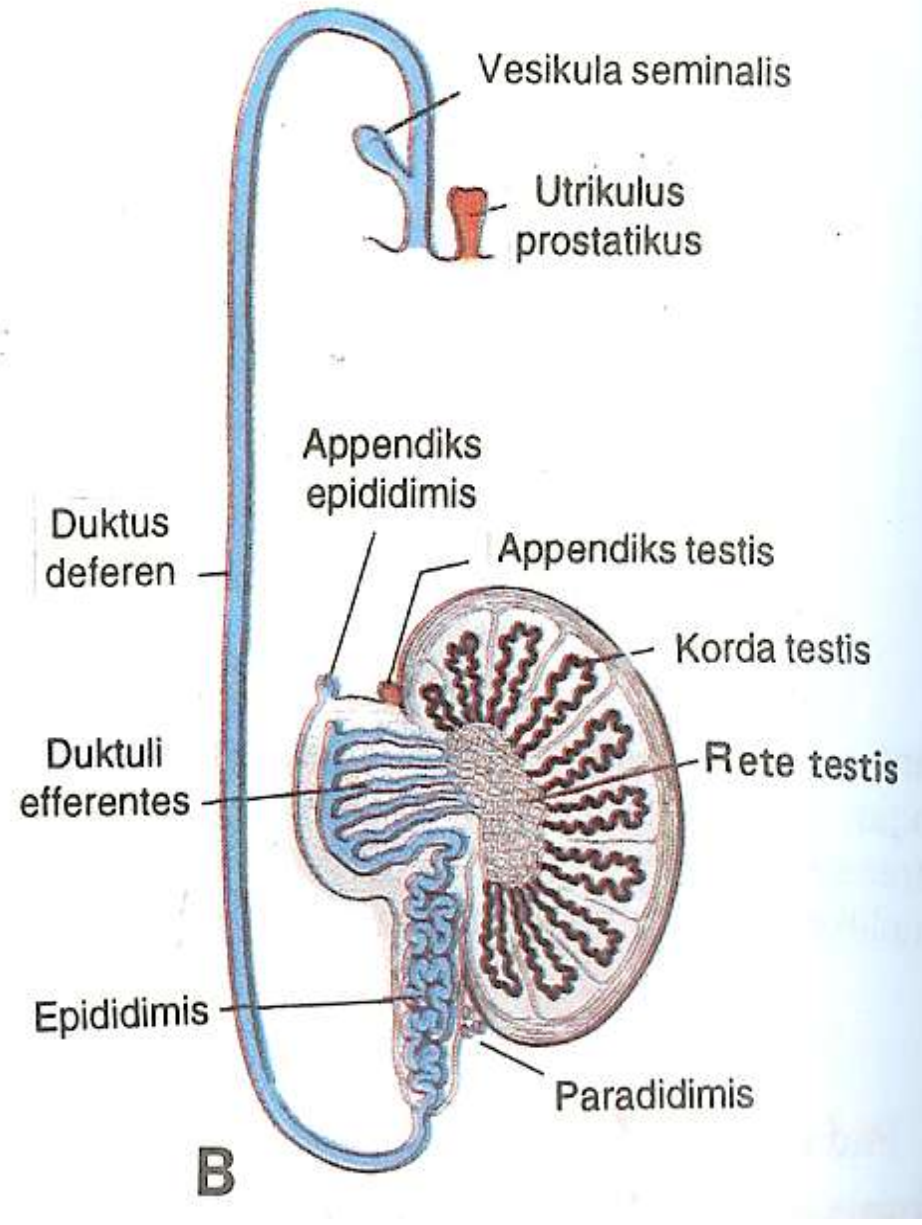
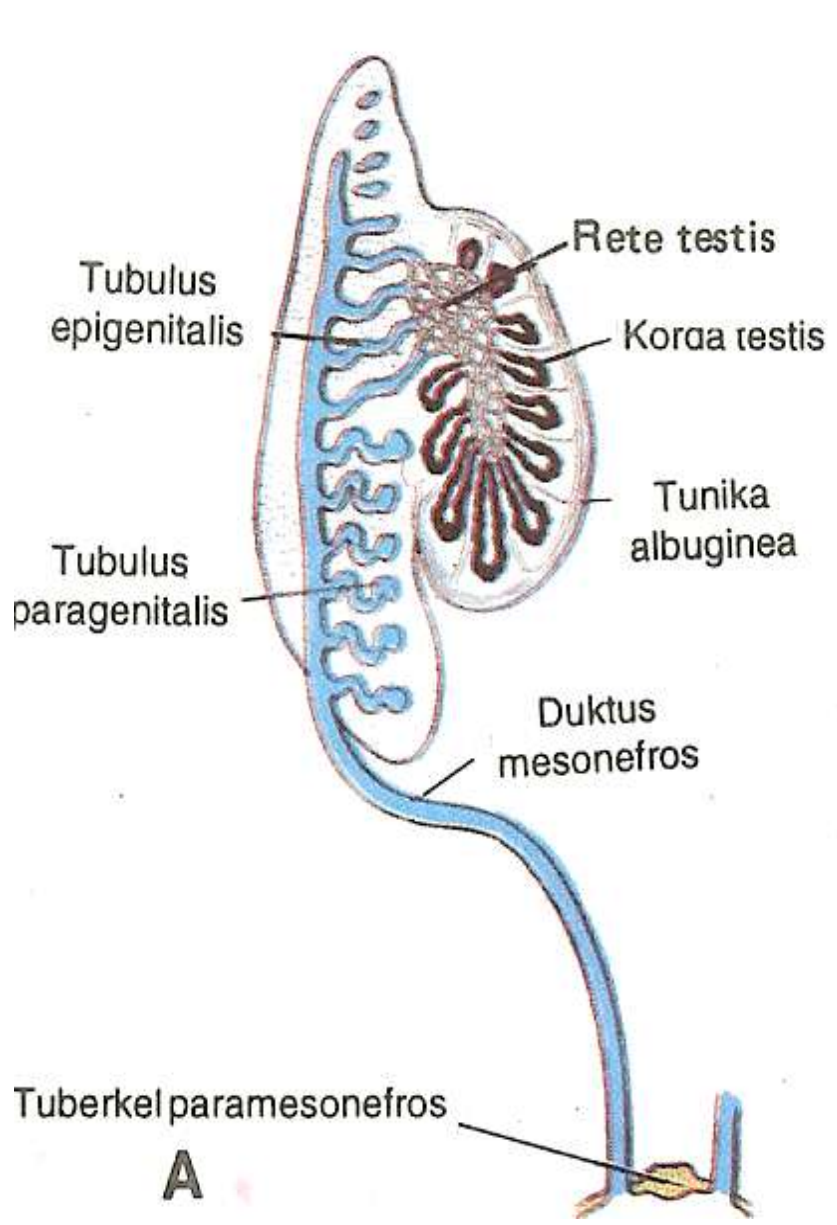


Gambar 10-9. Perkembangan testis yang diawali dengan masa indifferen.

2. Ductus genitalis

Berawal dari 2 pasang ductus genital:

- ductus mesonefros (ductus wolfii) :
 - membentuk *epididimis, vesica seminalis, ductus defferen dan ductus ejaculatorius*
- ductus paramesonefros (ductus mullerian) :
 - membentuk *appendix testis*



3. Genitalia externa

Berkembang di bawah pengaruh *androgen*

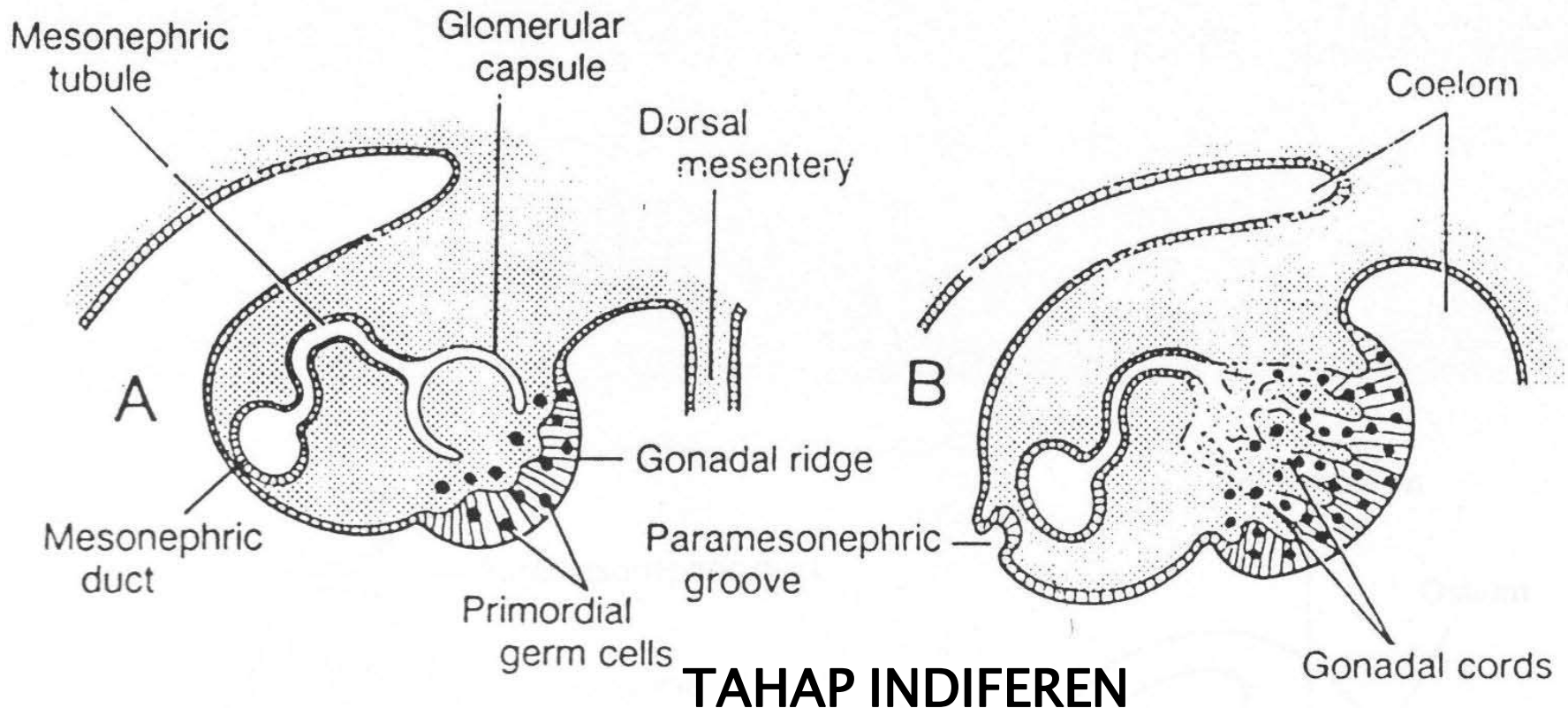
Berawal dari *tuberculum genital* yang memanjang
→ **phallus**

Phallus memanjang membentuk urethral groove →
urethral plate → **penile urethra** → terbentuk
lumen dan muara keluar → **meatus urethra
exsternus**

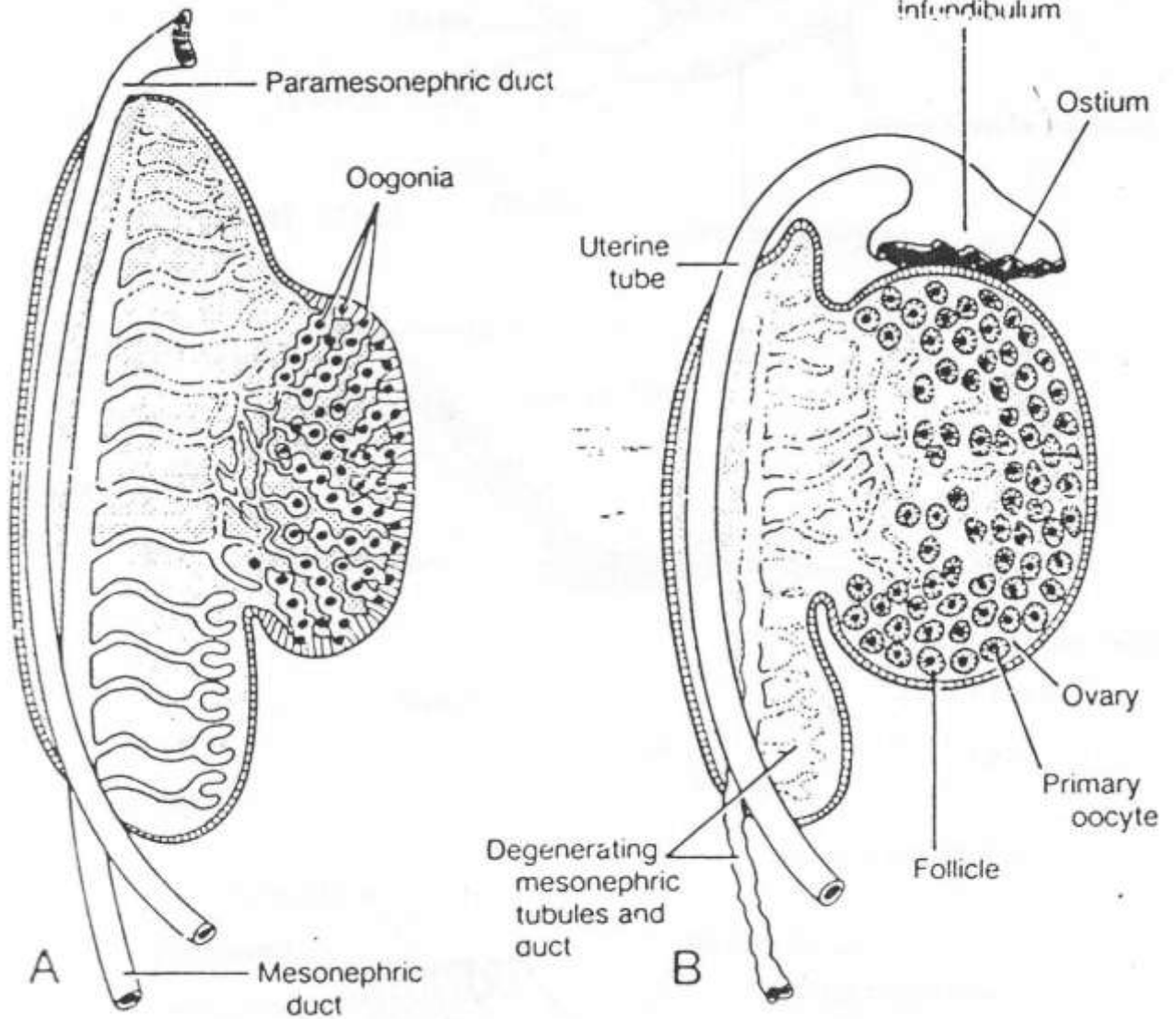
PERKEMBANGAN SISTEM GENITAL WANITA

■ Corda KELAMIN INDIFEREN → SUMSUM OVARIUM

■ SEL BENIH SEDERHANA → OOGONIA



WANITA



TAHAP
DIFERENSIASI

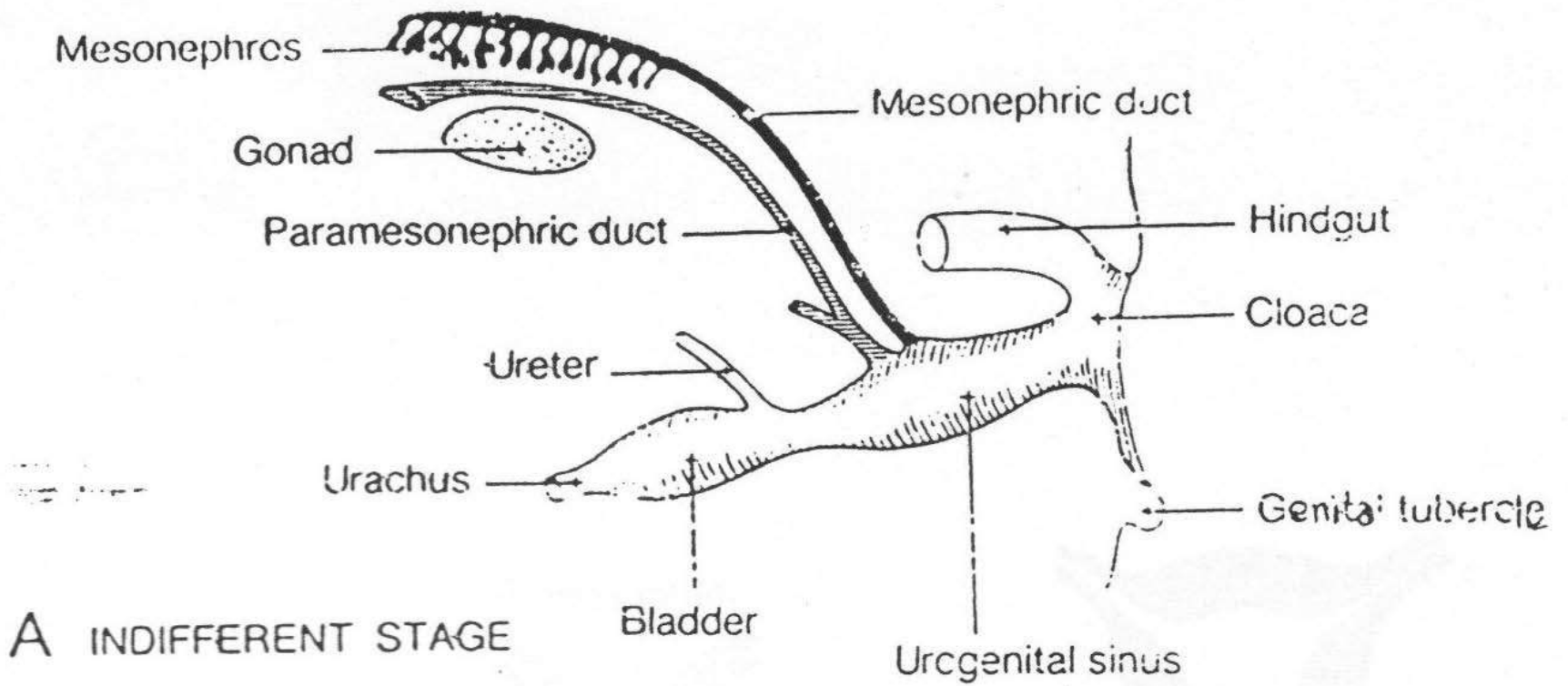
DUCTUS GENIALIS

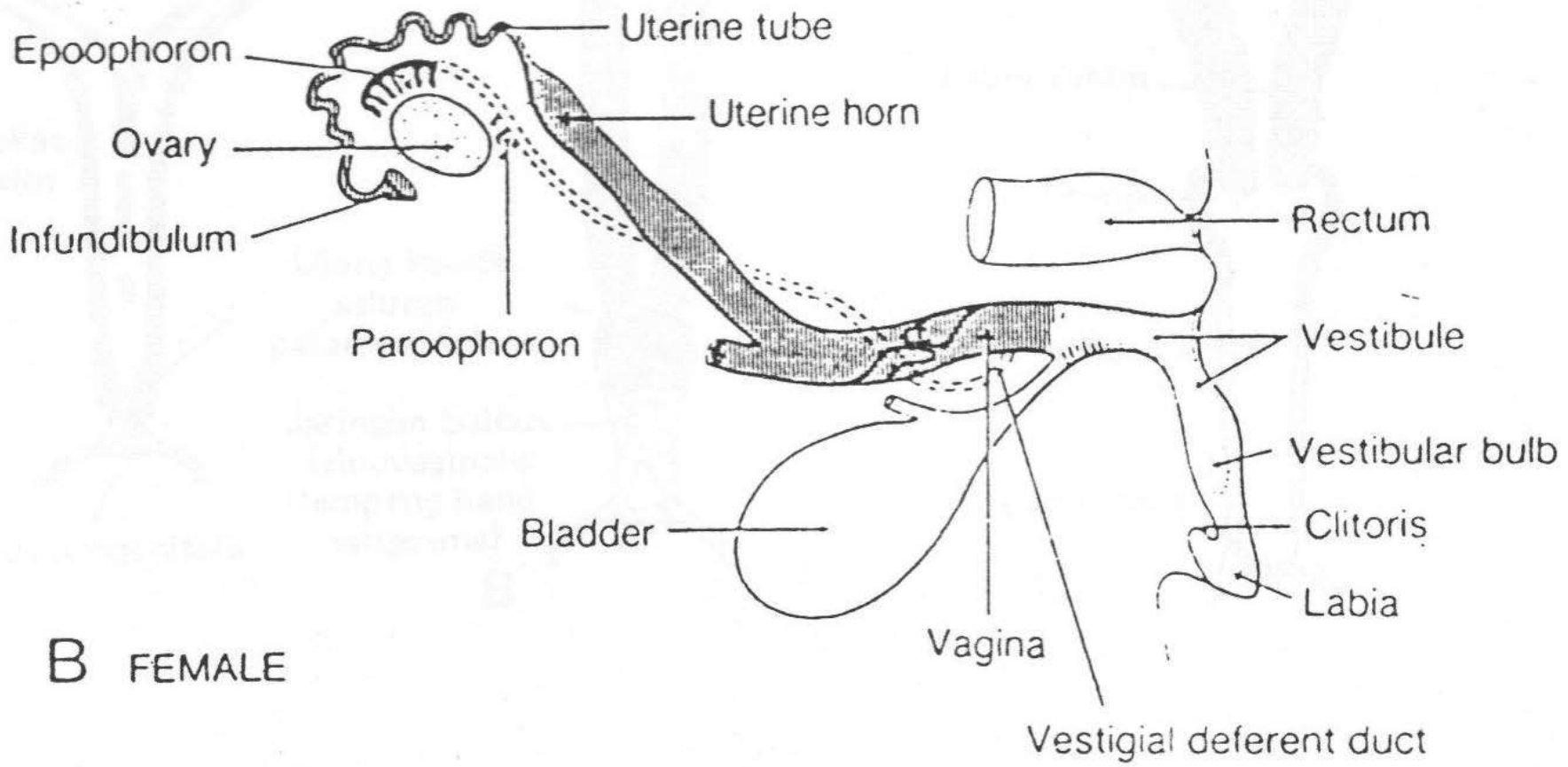
FASE INDIFEREN:

- SALURAN MESONEFROS
- SALURAN PARAMESONEFROS

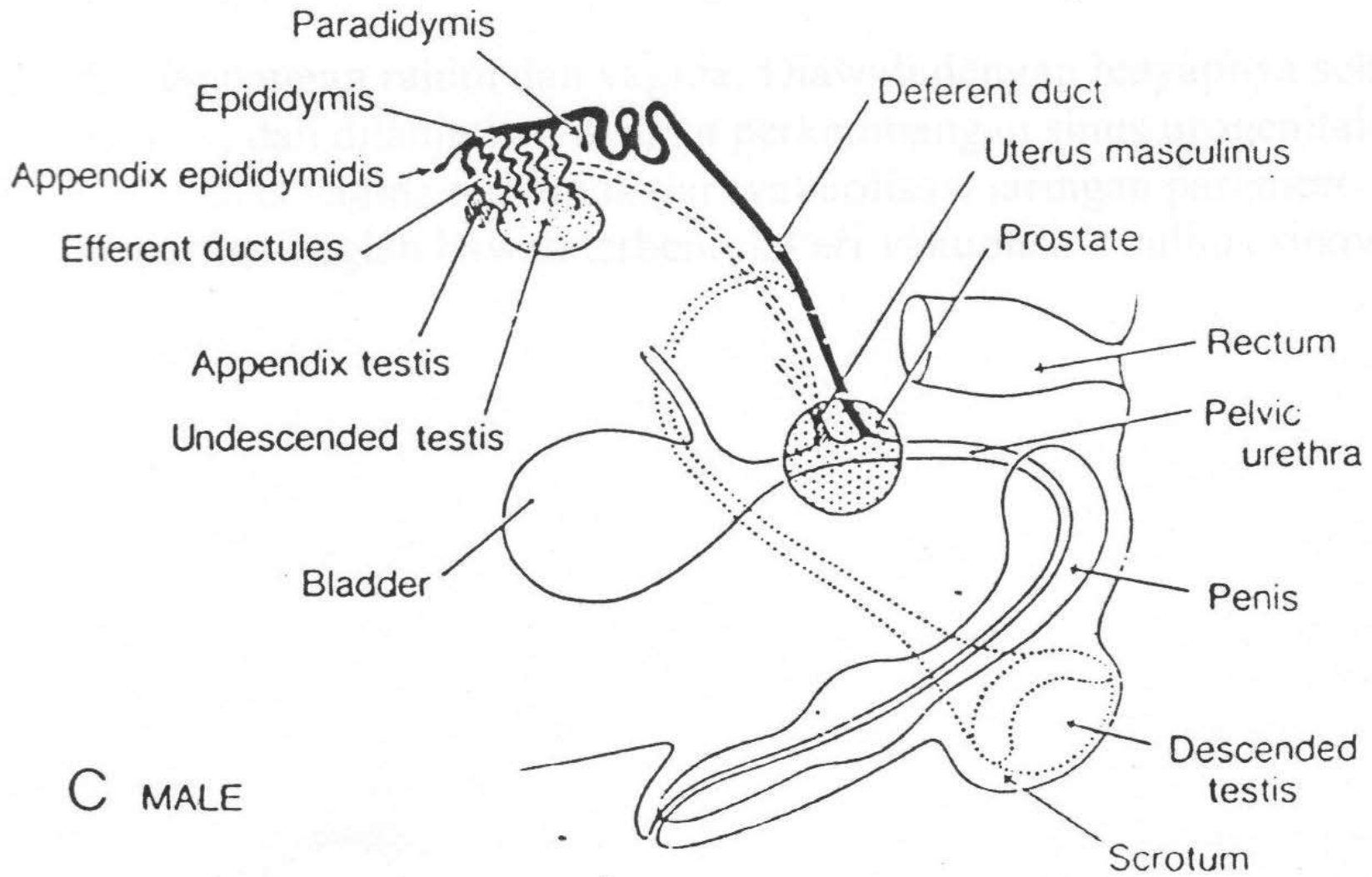
DIFERENSIASI SALURAN KELAMIN:

- ✿ HORMONAL
- ✿ MIS = MULLERIAN INHIBITING SUBSTANCE





B FEMALE



C MALE

ANDROGEN:

- PERTUMBUHAN PENIS .
- PERTUMBUHAN URETRA PARS CAVERNOSA
- PENYATUAN SCROTUM
- PERKEMBANGAN PROSTAT & VESICULA SEMINALIS

SAL. MESONEFROS (WOLFF):

- DUCTULI EFERENTES
- DUCTULI EPIDIDYMIS
- DUCTUS DEFERENTES

SAL. PARAMESONEFROS:

- DEGENERASI → APPENDIX TESTIS

ESTROGEN:

- PERKEMB. SAL. PARAMESONEFROS ⇒ RAHIM
- PERKEMB. LABIA MAJOR & MINOR
- PERKEMB. CLITORIS
- PERKEMB. VAGINA

SAL. PARAMESONEFROS:

- SAL. TELUR = OVIDUCT
- SAL. RAHIM = UTERUS, CERVIX,
SEBAGIAN VAGINA

VAGIN

ASAL:

- JAR. PARAMESONEFROS (1 / 3 ATAS)
- JAR. BULBUS SINOVAGINALIS (2 / 3 BAWAH)

HYMEN (SELAPUT DARA):

- ➔ BATAS ANTARA RONGGA VAGINA DAN SINUS UROVAGINALIS

ALAT KELAMIN LUAR:

TAHAP INDIFEREN:

■ MEMBRANA CLOACALIS:

⇒ ■ MEMBRANA UROGENITALIS

⇒ ■ MEMBRANA ANALIS

■ TUBERCULUM GENITALE: BAKAL

⇒ ■ PENIS / CLITORIS

LAKI- LAKI:

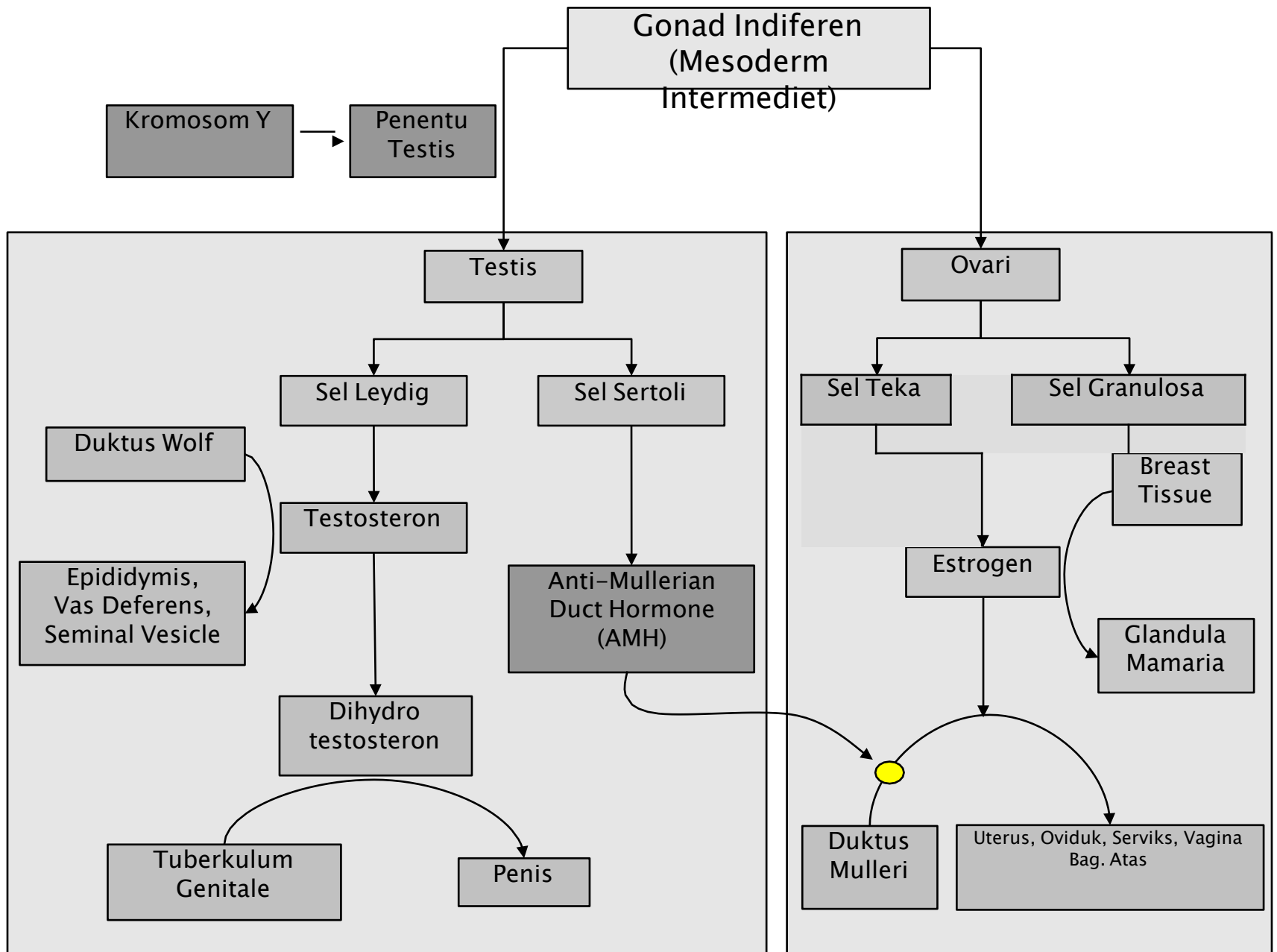
ALUR + LIPATAN URETRA = URETRA PARS CAVERNOSA

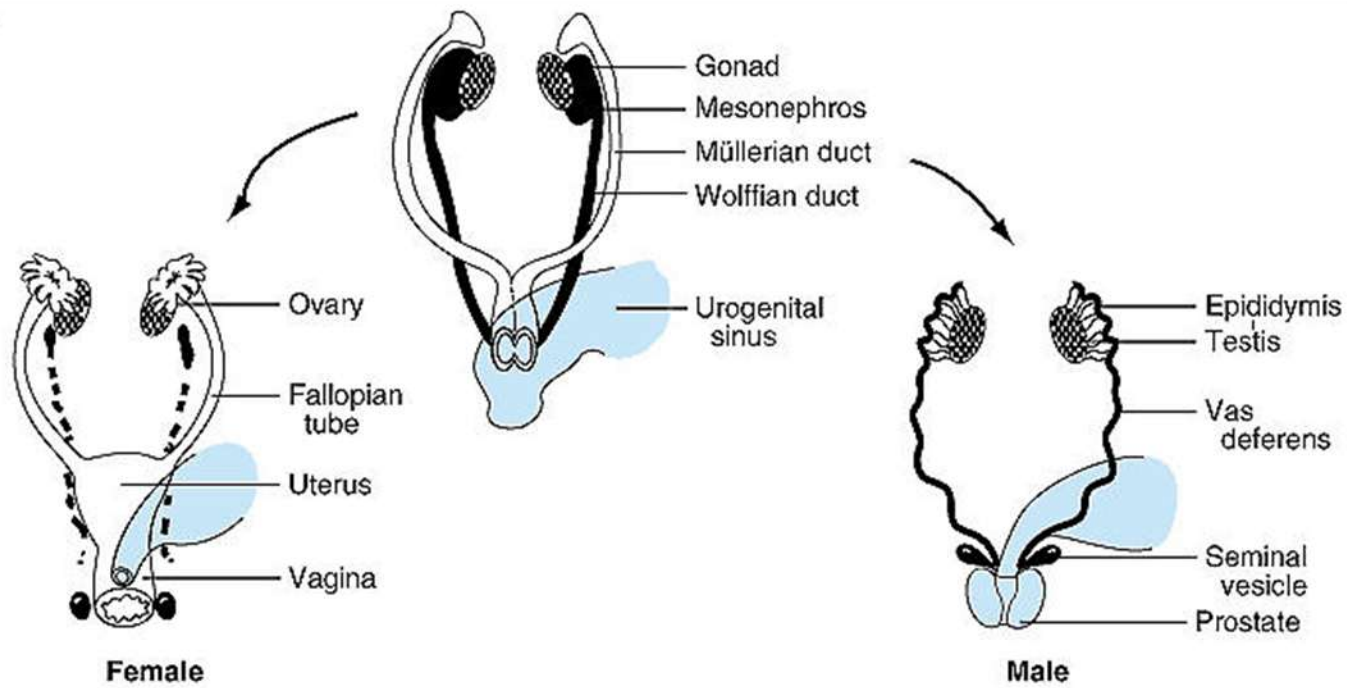
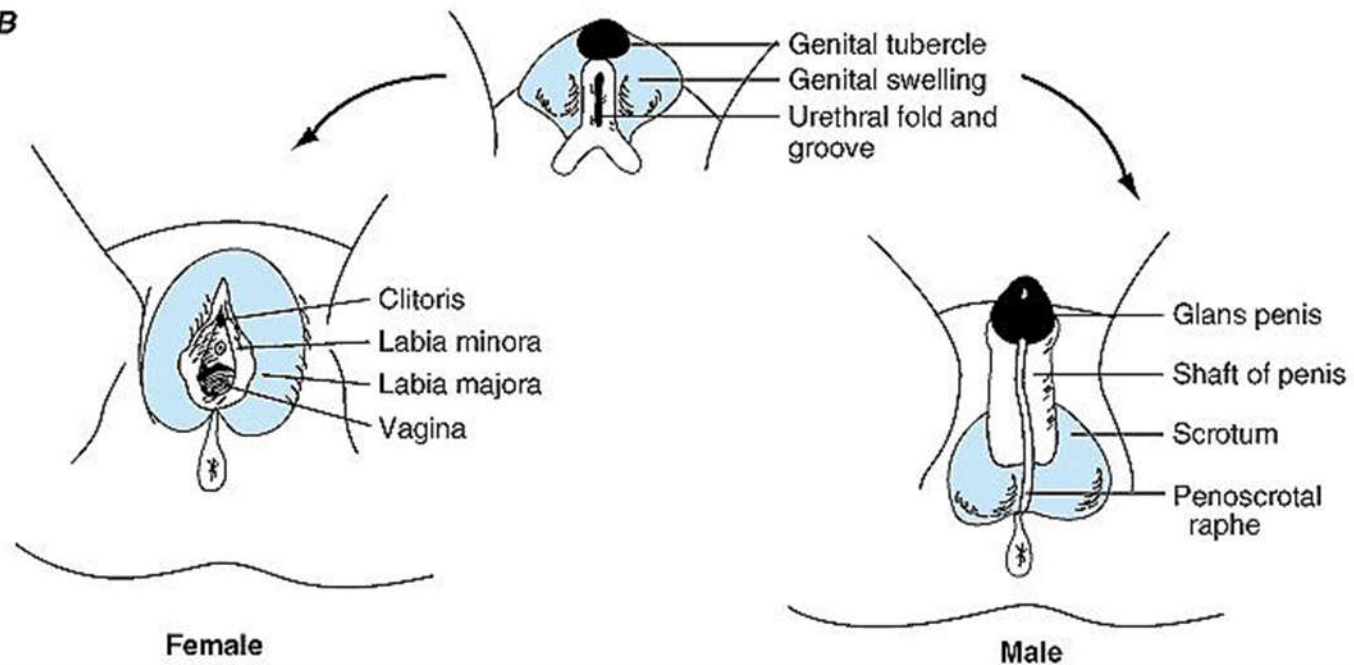
HYPOSPADIA: lipatan uretra tidak menutup sempurna

EPISPADIA : ~ hypospasia di bag. dorsal (penis terbelah)

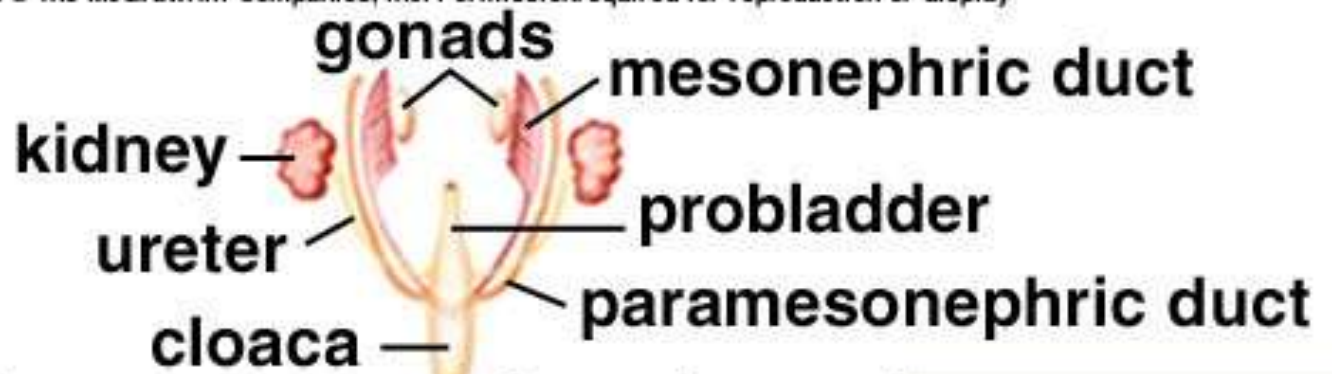
PEREMPUAN:

- LIPATAN URETRA TIDAK BERSATU → LABIA MINOR
- TONJOLAN KELAMIN → LABIA MAJOR
- ALUR UROGENITALIS TERBUKA → VESTIBULUM



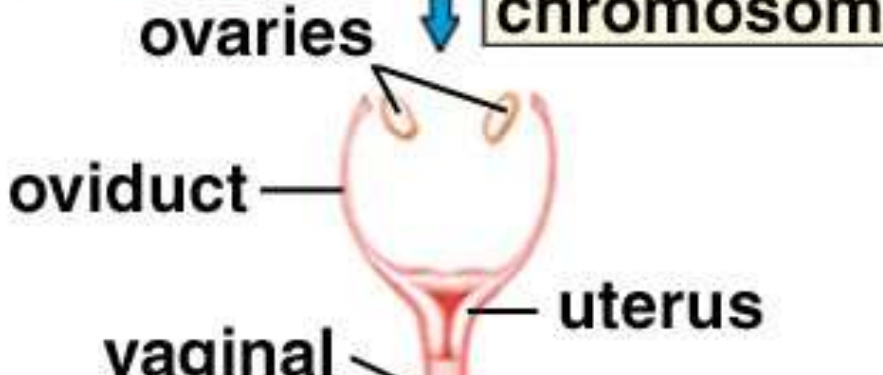
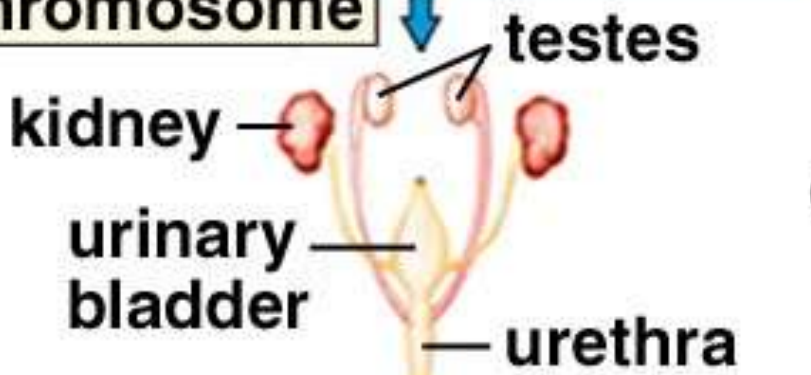
A**B**

Male and Female Organs



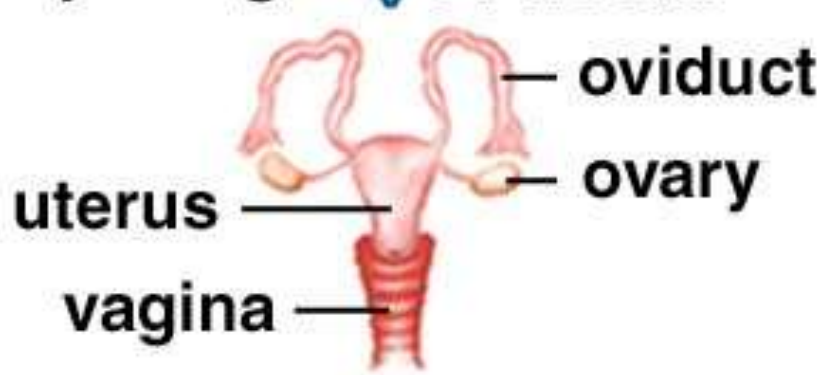
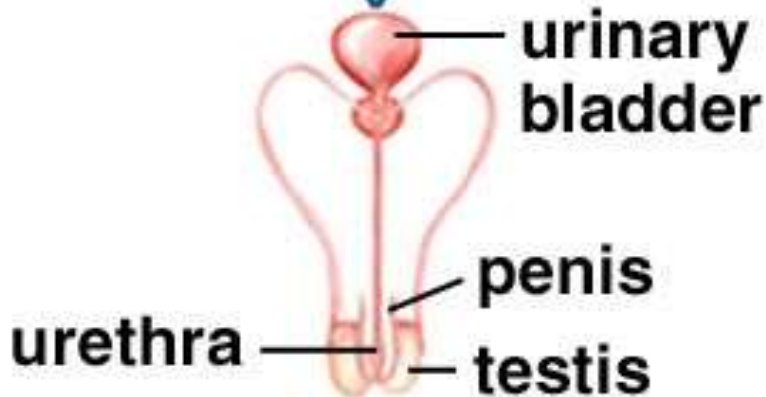
Y chromosome

no Y chromosome

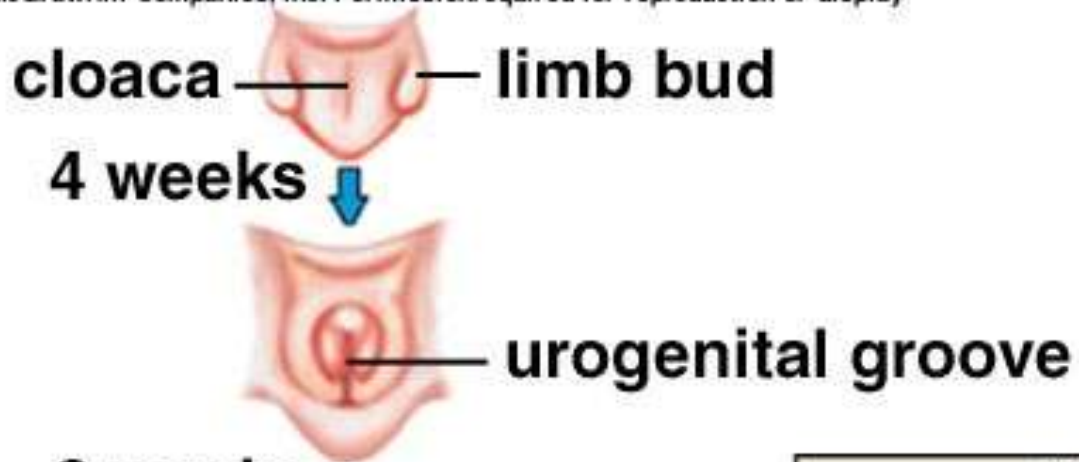


14 weeks

14 weeks



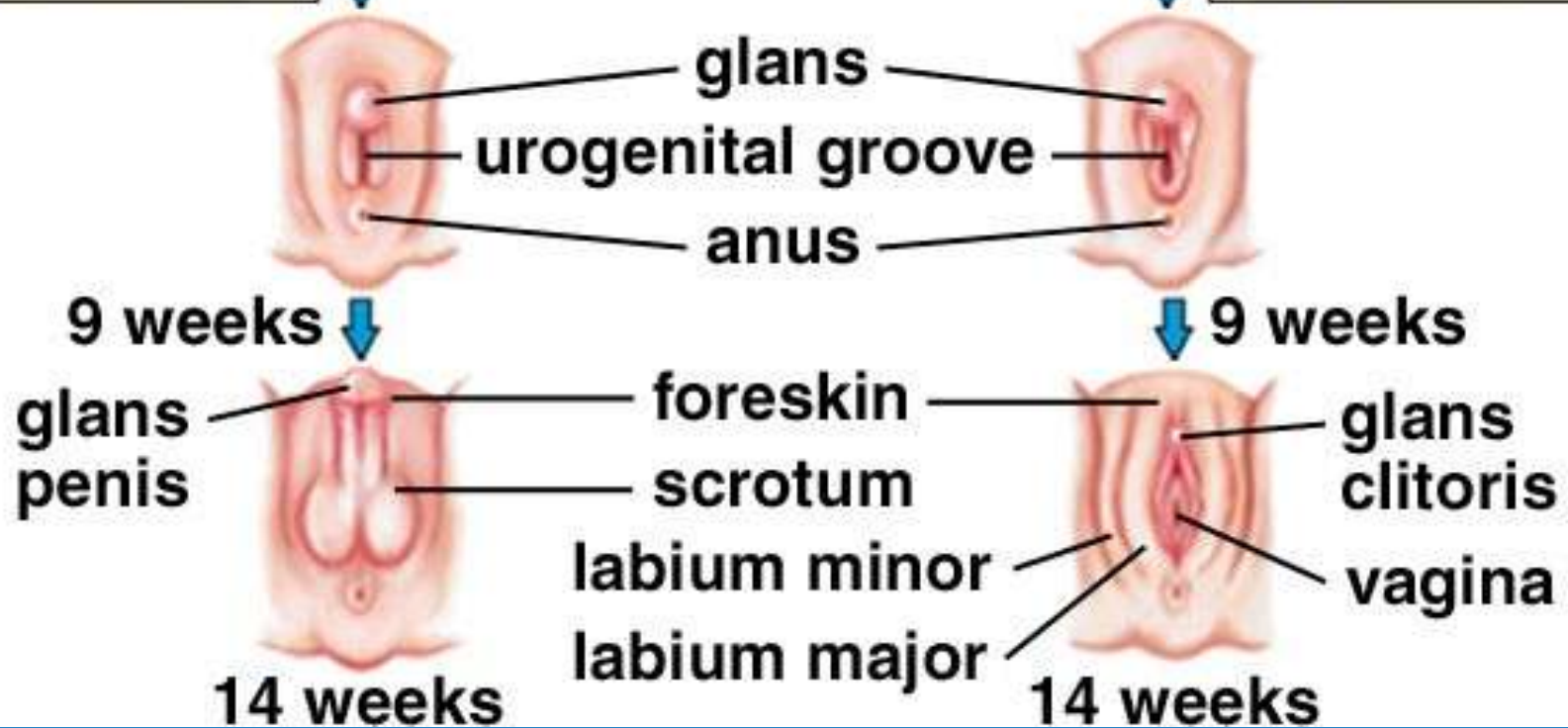
Male and Female Organs



Y chromosome

6 weeks

no Y chromosome

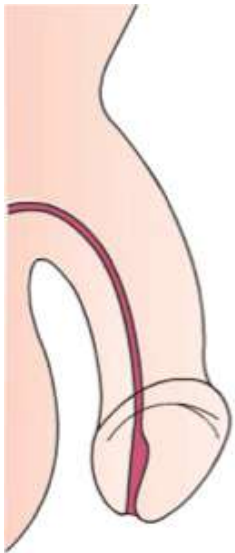


DEVELOPMENT HOMOLOGUES OF MALE & FEMALE Genital System

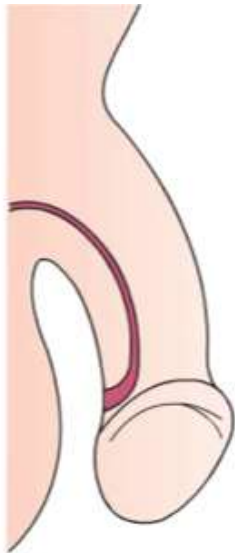
Male	Indifferent Stage	Female
1. Testis	Gonad	Ovary
2. Epididymis duct defferent duct	mesonephric duct (Wolffian duct)	bladder epophorus
3. Prostaticus	paramesonephric duct (Mullerian duct)	uterine tube uterus
4. Glands penis	Glans of pallus	Glands clitoris
5. Scrotum	genital swelling	labia majora
6. Urethra penil	urethral fold	labia minor
7. Gubernaculum testis	gubernaculum	ligament of ovary ligament of uterus

Clinical Features (Male)

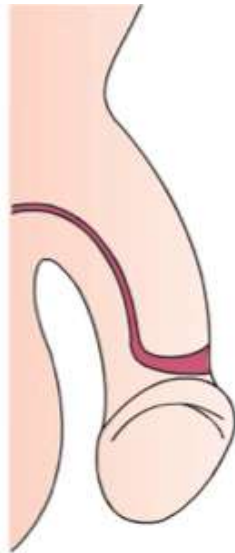
- **HIPOSPADIA** : penyatuan lipatan uretra tidak sempurna
- **EPISPADIA** : muara urethra terdapat pada dorsum penis
- **MIKRO PENIS** : perangsangan androgen tidak cukup untuk menumbuhkan genitalia eksterna



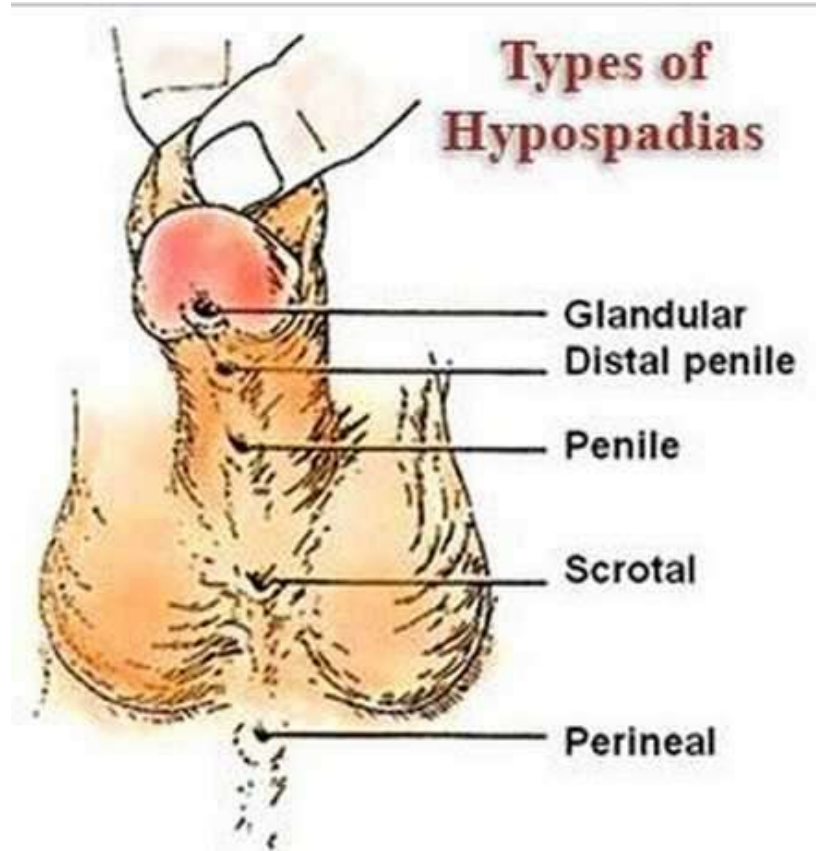
A. Normal



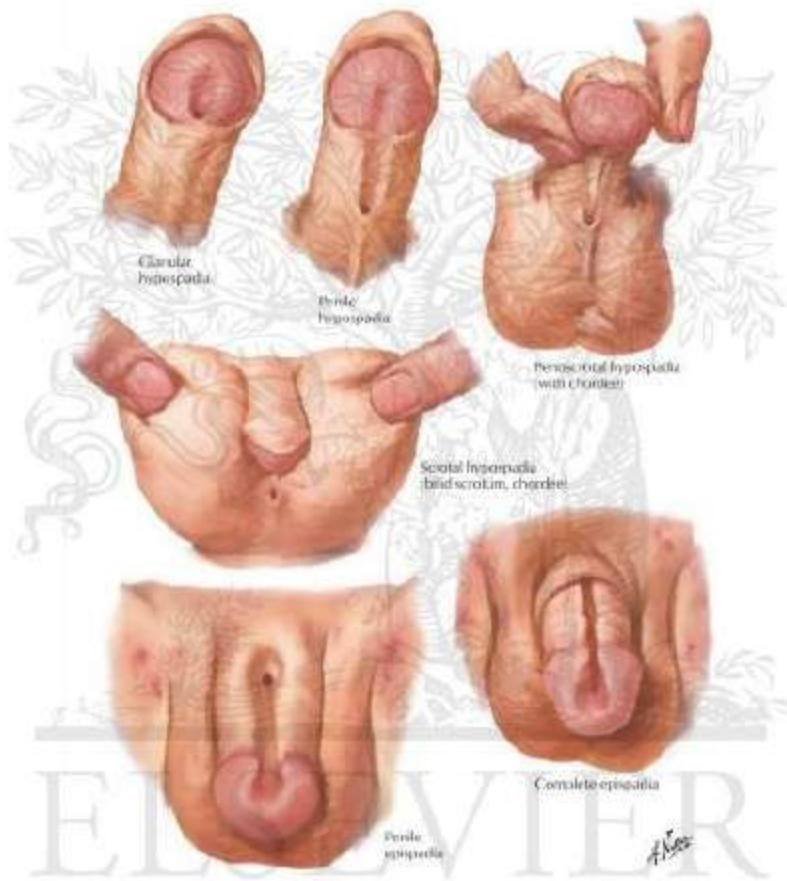
B. Hypospadias



C. Epispadias

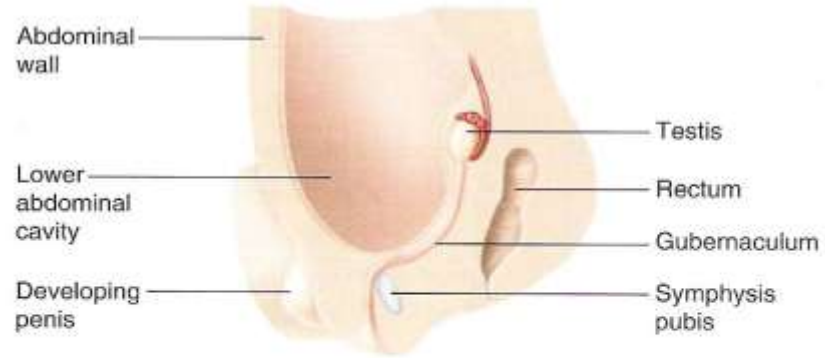


Mikropenis

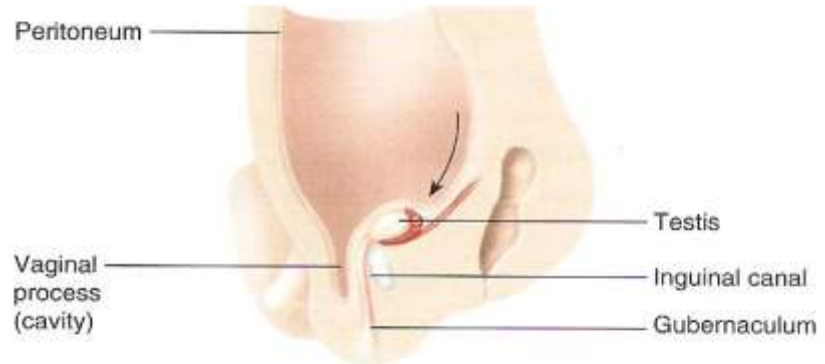


Decensus Testicularum (minggu ke- 34)

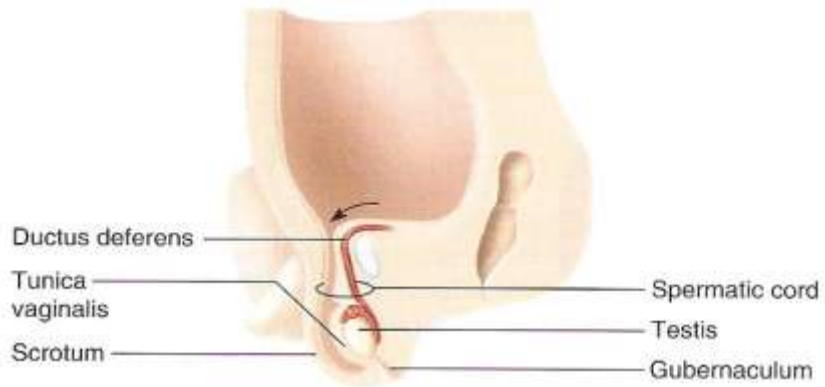
Testis turun ke arah penonjolan scrotum dengan mengikuti “arahan” dari gubernaculum



(a)



(b)



Undecensus testicularum- kriptoohirmus

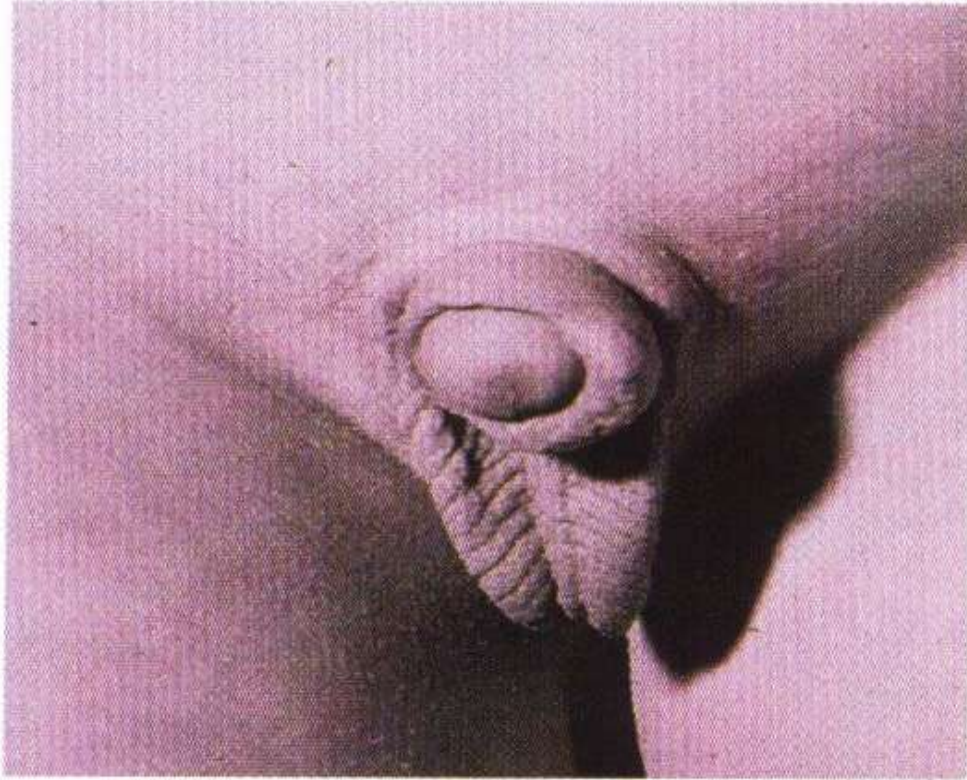
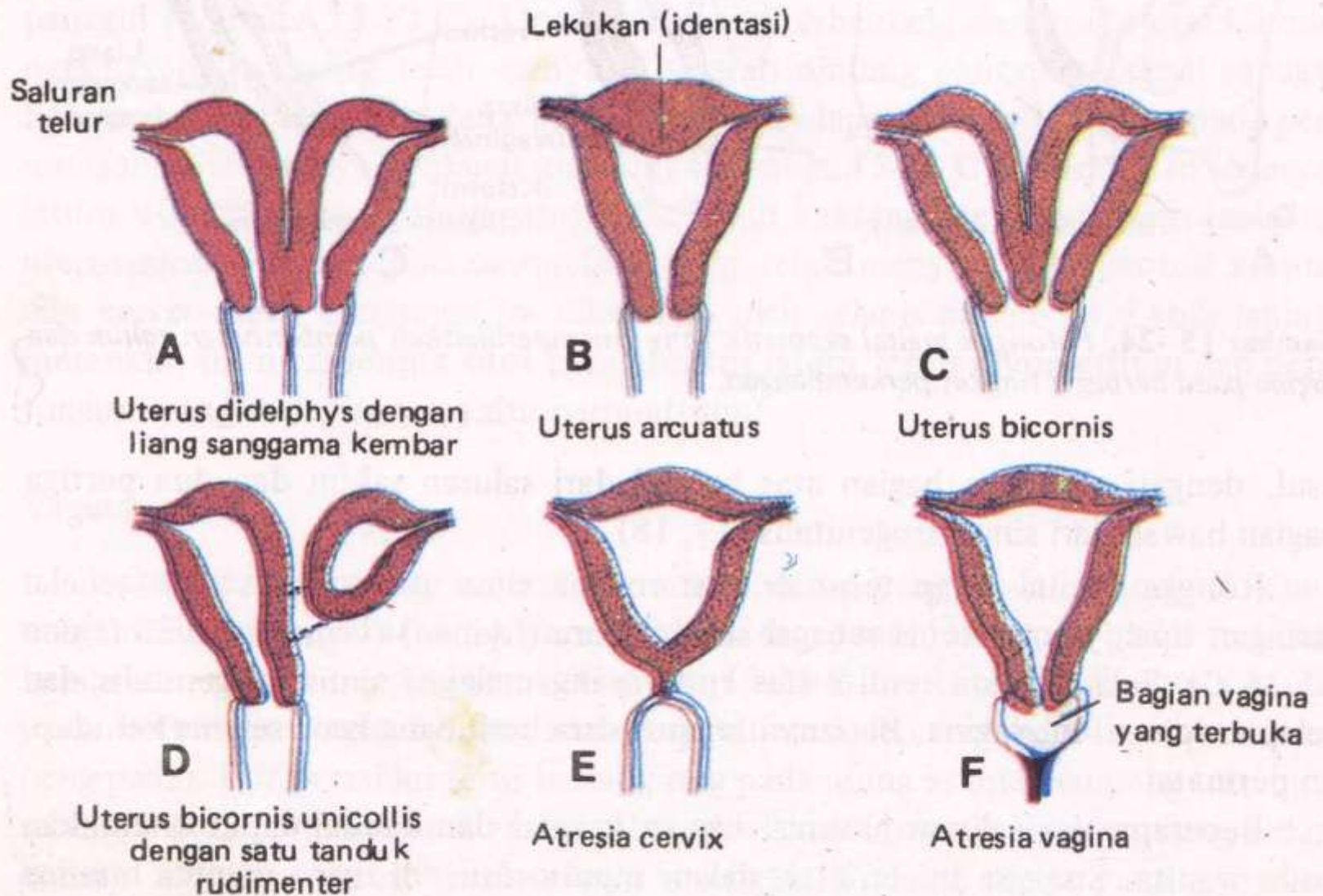


FIGURE 2 Cryptorchidism. An empty scrotum in a 13-year-old boy. The testes were in the internal inguinal ring.

ABNORMALITAS (wanita):

- UTERUS DIDELPHYS
- UTERUS URACUATUS
- UTERUS BICORNIS
- UTERUS BICORNIS UNICOLLIS
- ATRESIA CERVIX
- ATRESIA VAGINA



Gambar 15–25. Gambar skematik kelainan utama rahim dan vagina, yang disebabkan oleh menetapnya sekat rahim atau menutupnya rongga saluran rahim.