

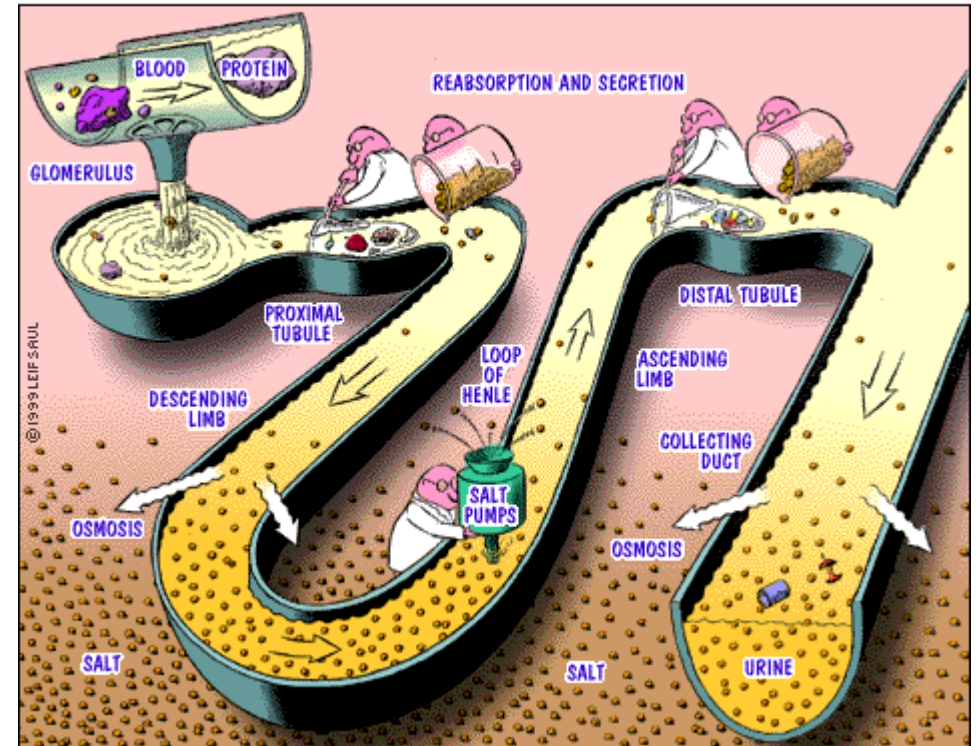
# MUNI

## URINARY SYSTEM

Dentistry-spring

The nephron as a water treatment facility

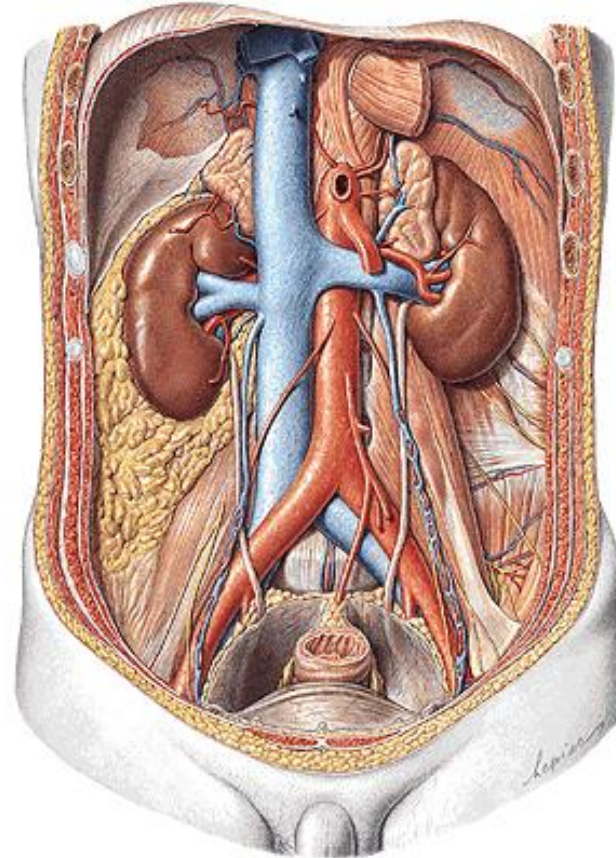
IPHY 3410-100, Leif Saul



<https://www.colorado.edu/intphys/iphy3410saul/outlines08fall/nephron.gif>

# FUNCTIONS

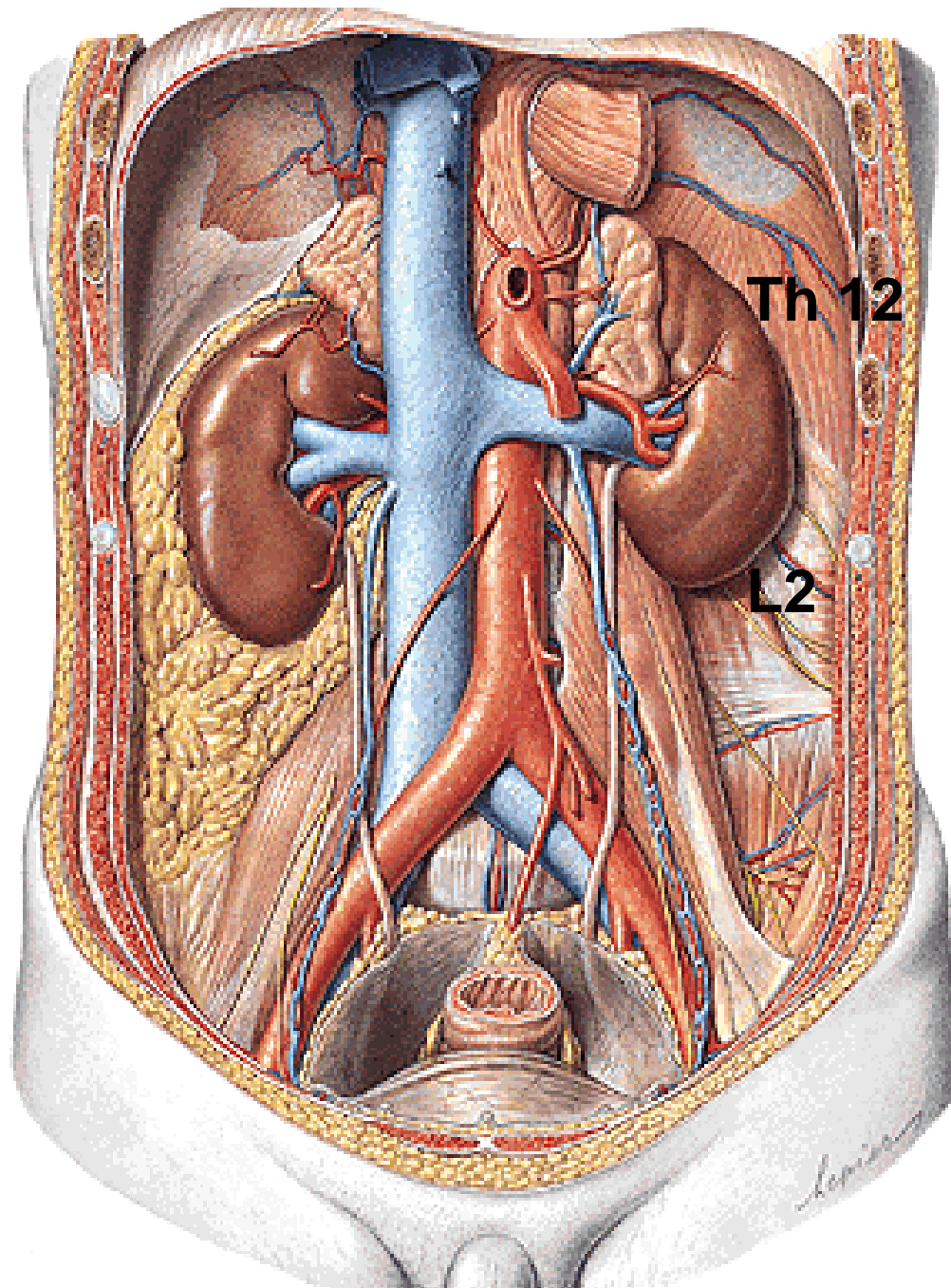
- Removal of waste product from the body
- Regulation of electrolyte balance
- Regulation of acid-base homeostasis (blood pH)
- Controlling blood volume and maintaining blood pressure



# PARTS

**Kidney (ren)**

**Efferent urinary tract:**  
renal calices  
renal pelvis  
ureter  
urinary bladder  
urethra



# KIDNEY Ren (nephros)

## Syntopy

## Topography

dorsaly – abdominal wall

diaphragm

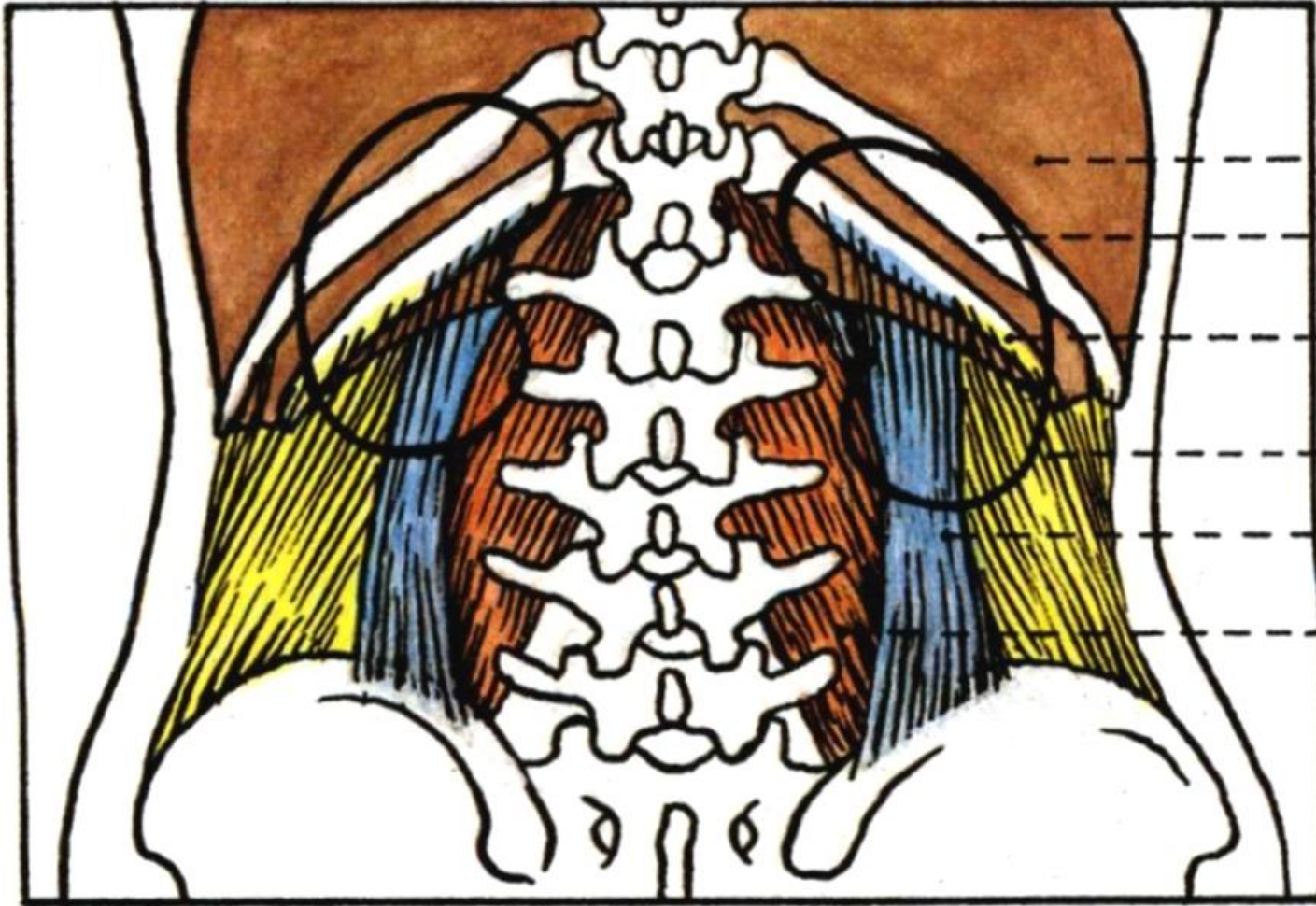
muscles

Co 12

nerves (plx. lumbalis)

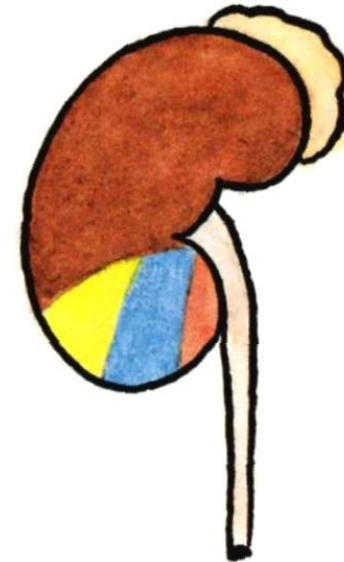
1. Diaphragma
2. 11<sup>th</sup> rib
3. 12<sup>th</sup> rib

4. M. transversus abdominis
5. M. quadratus lumborum
6. M. psoas major

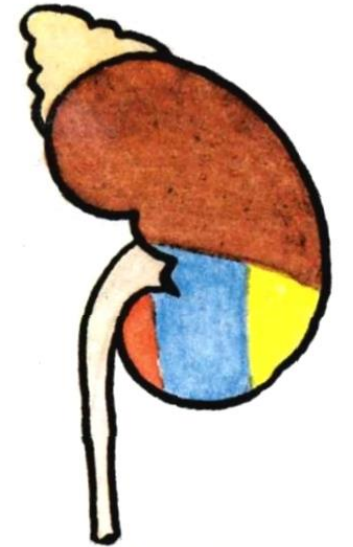


SIN.

DX.

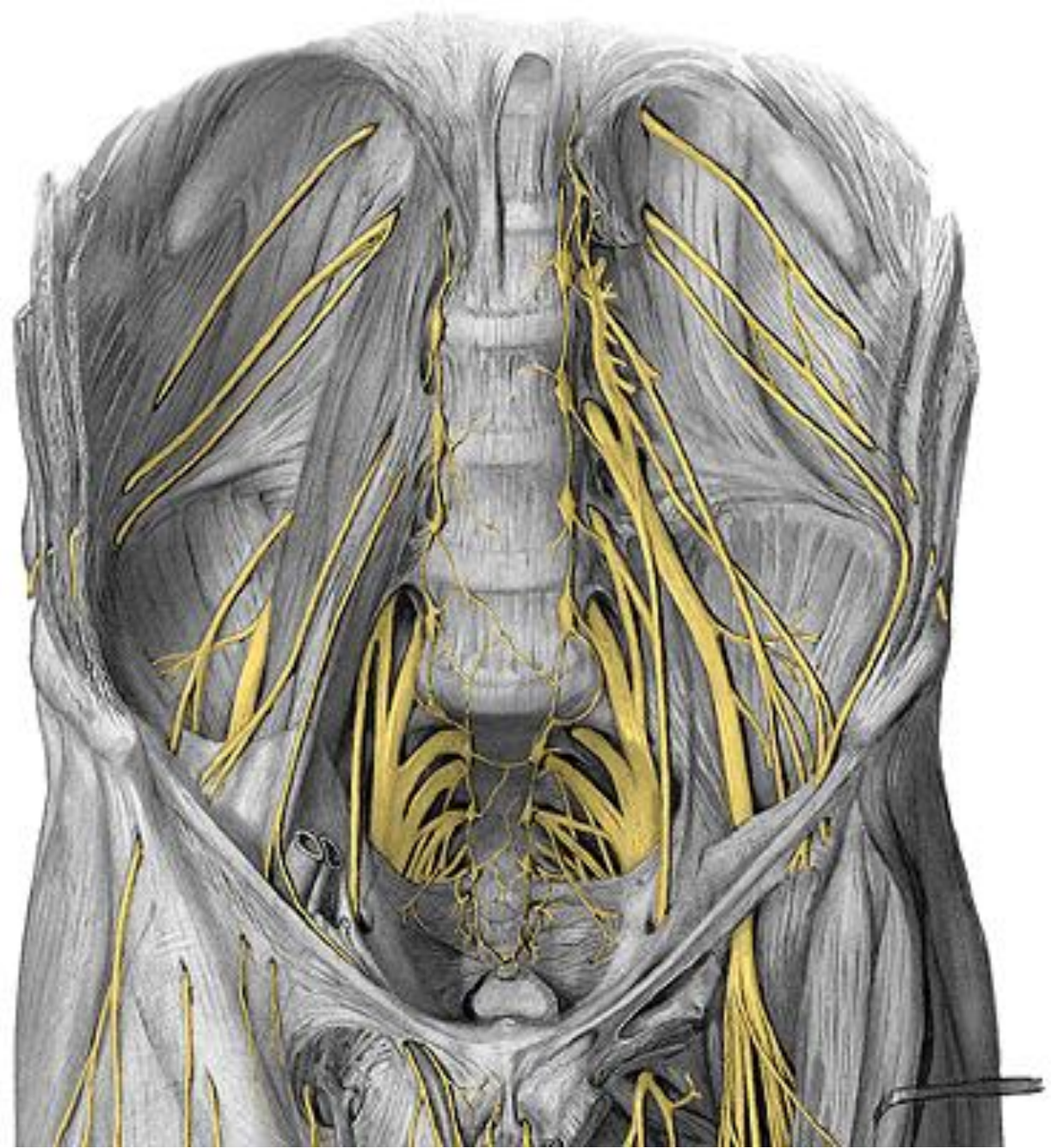


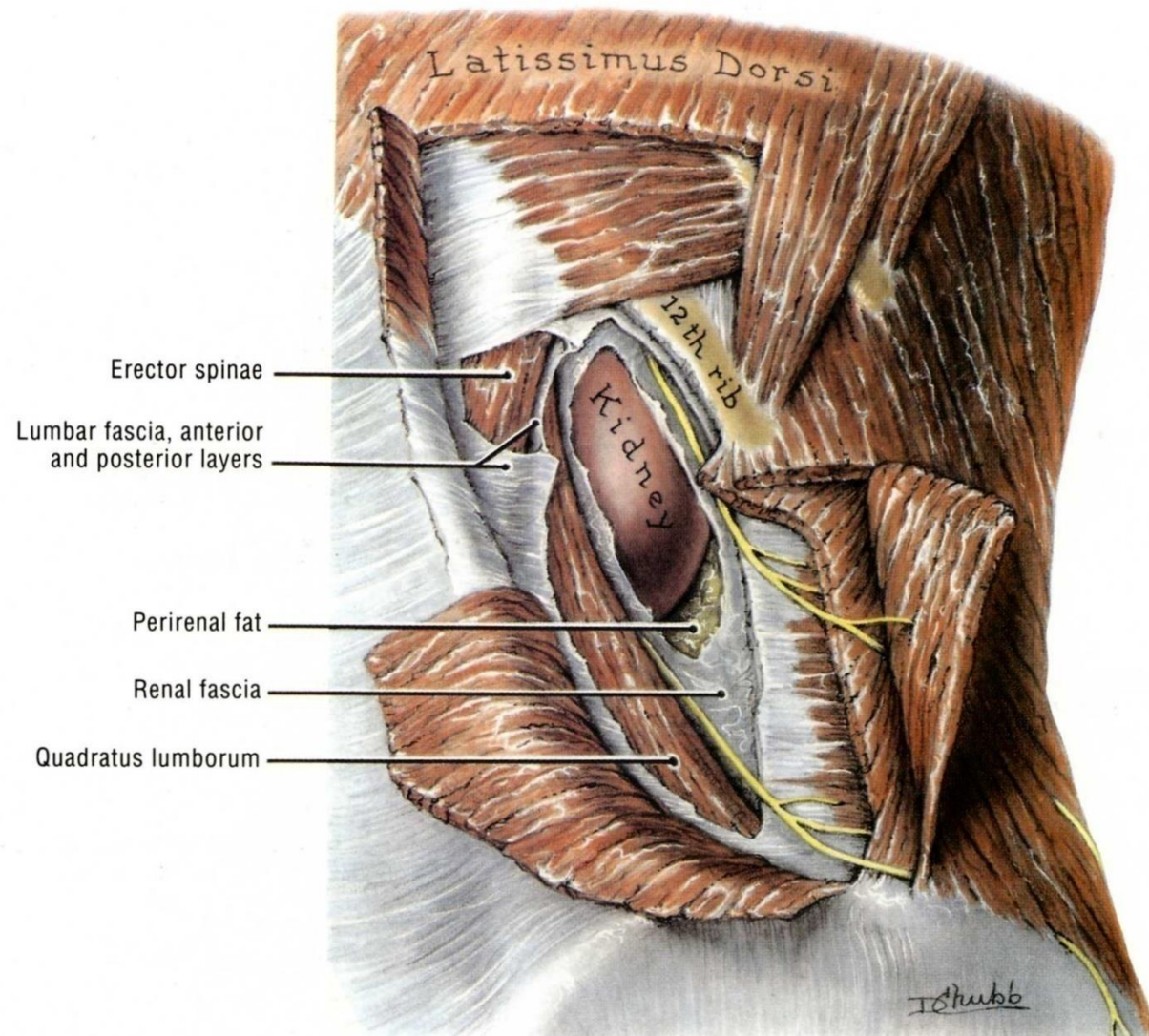
SIN.

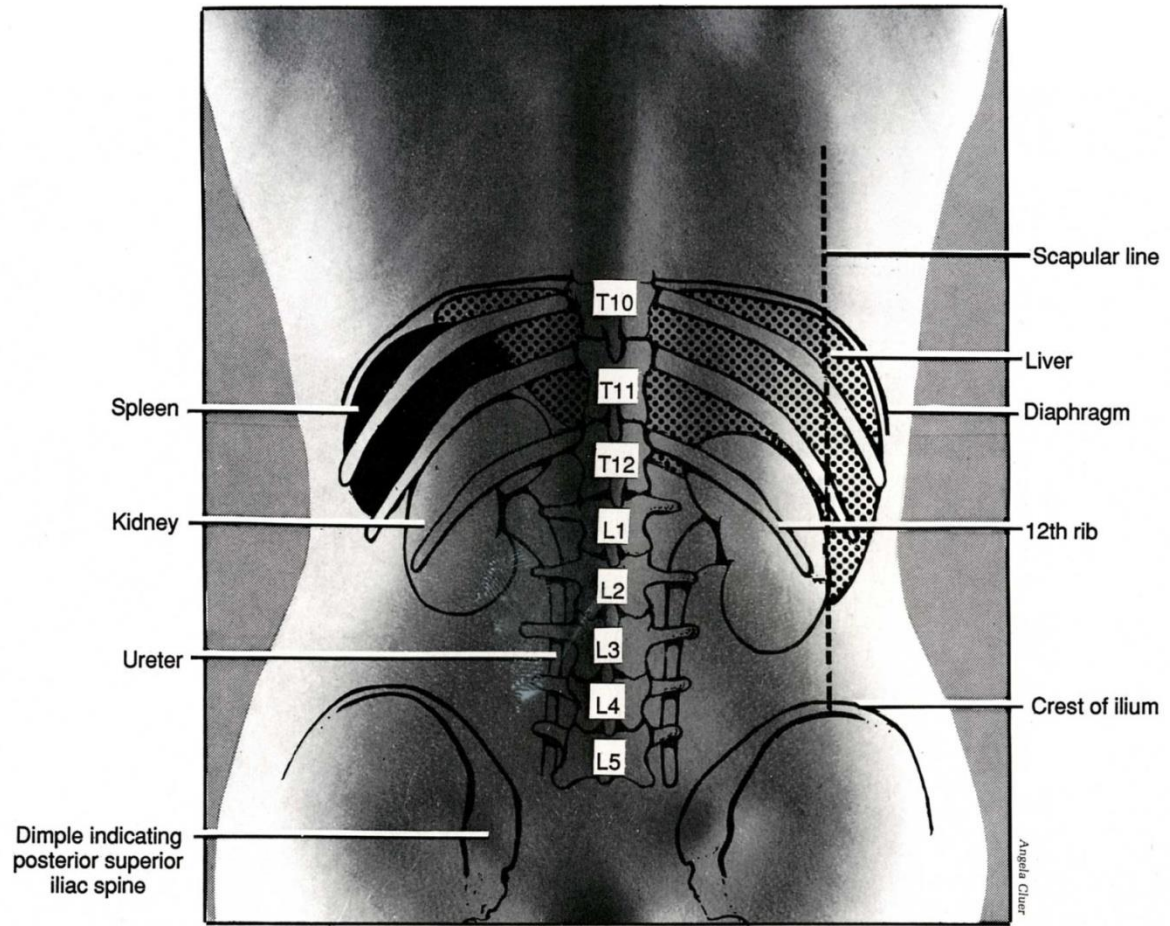
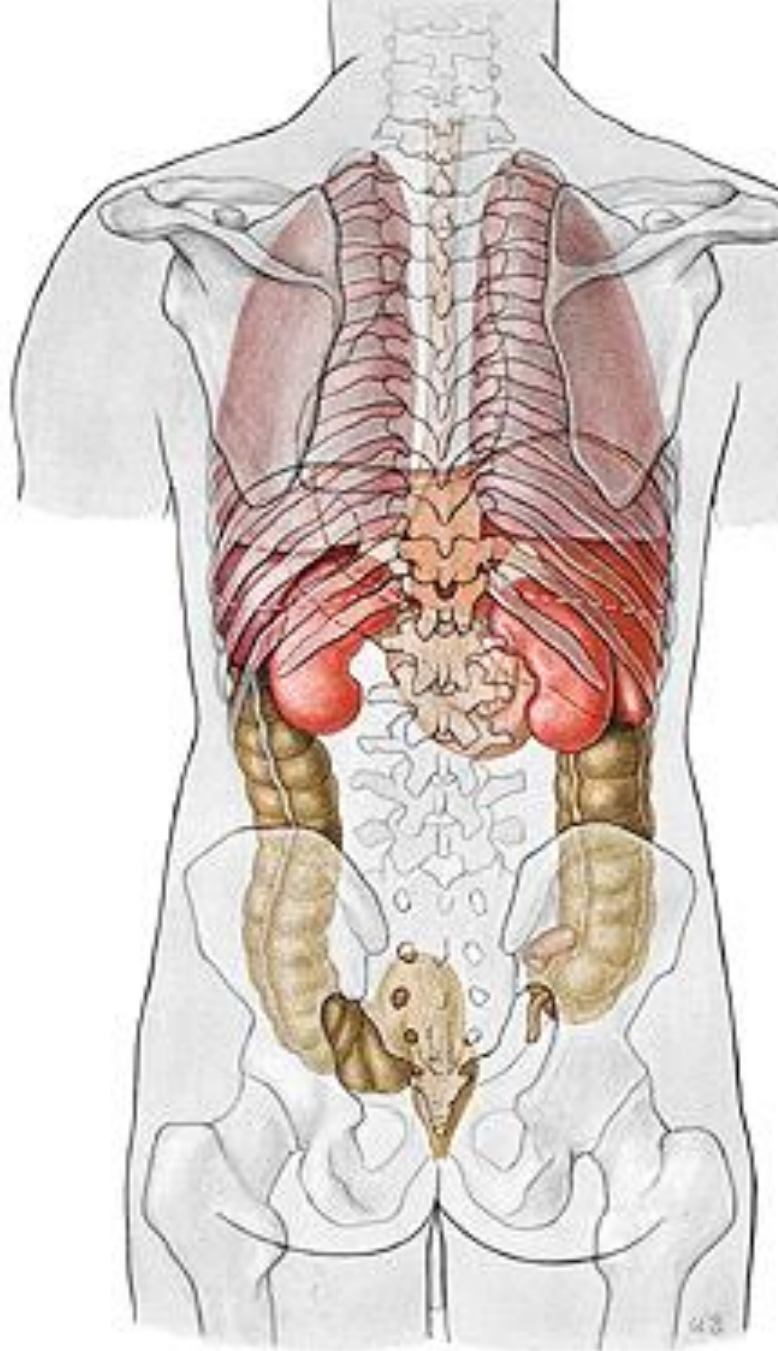


DX.

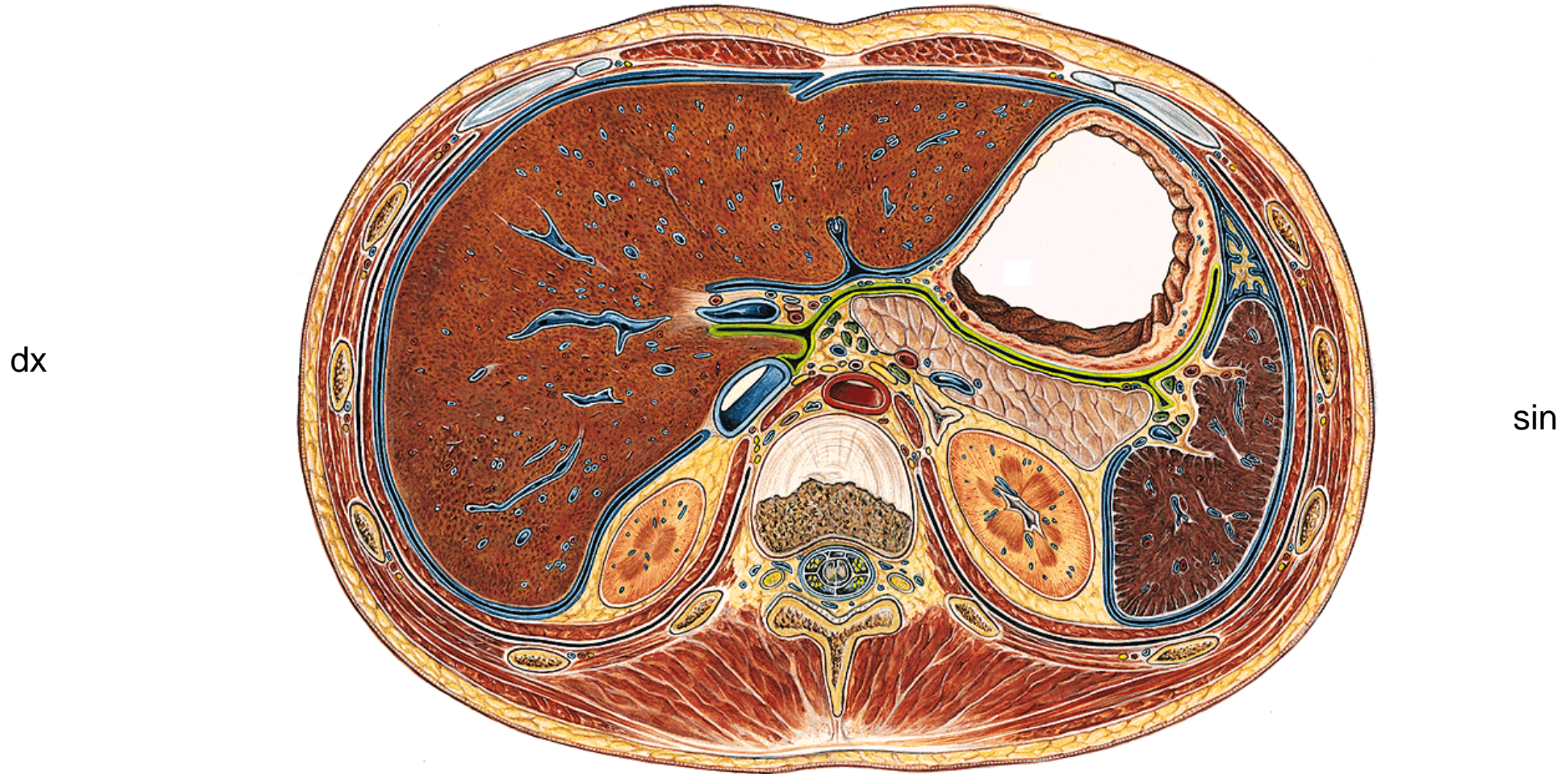
**N. subcostalis**  
**N. iliohypogastricus**  
**N. ilioinguinalis**







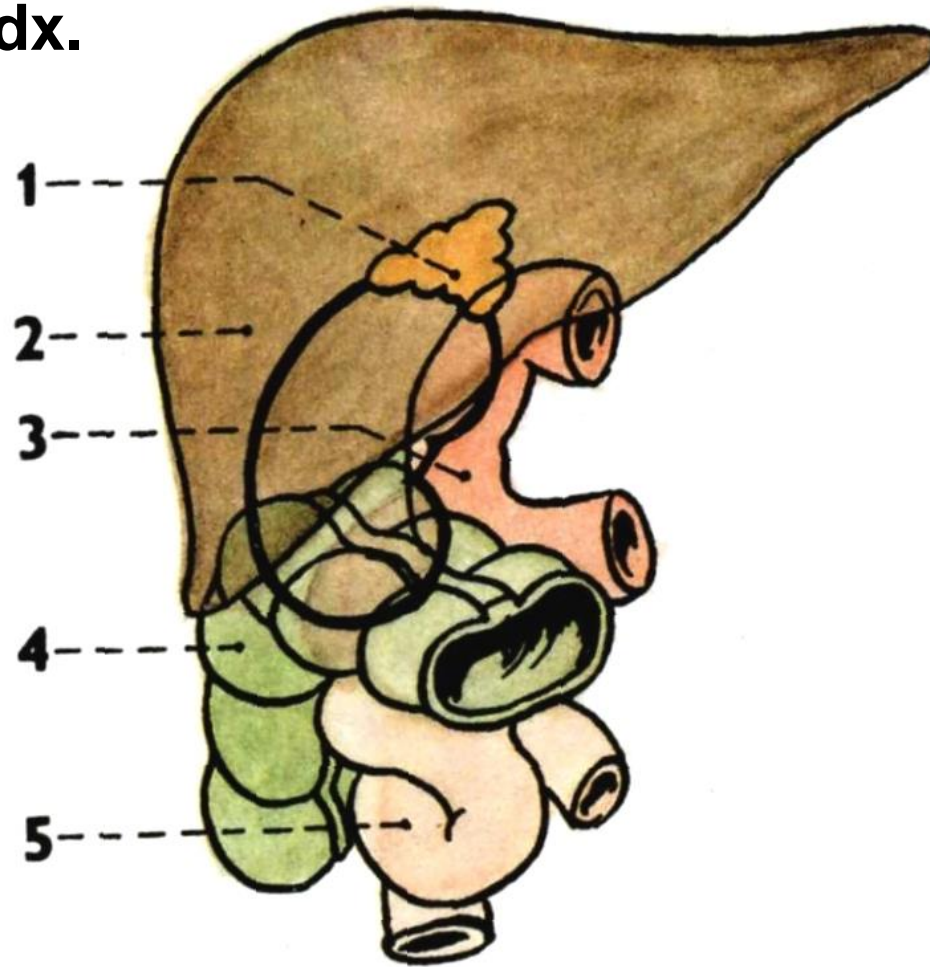
Transverse section through the intervertebral disc between T12 and L1



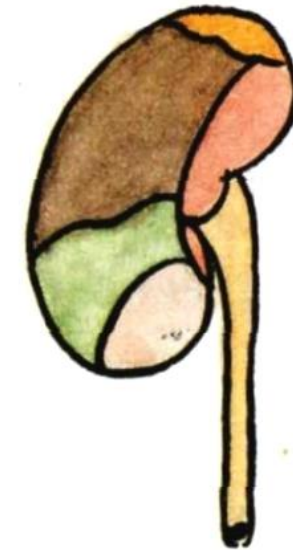
Ventrally – peritoneal cavity  
liver, colon, stomach, pancreas, spleen



1. Gl. suprarenalis dx.
2. Liver
3. Duodenum
4. Flexura coli dx.
5. Jejunum

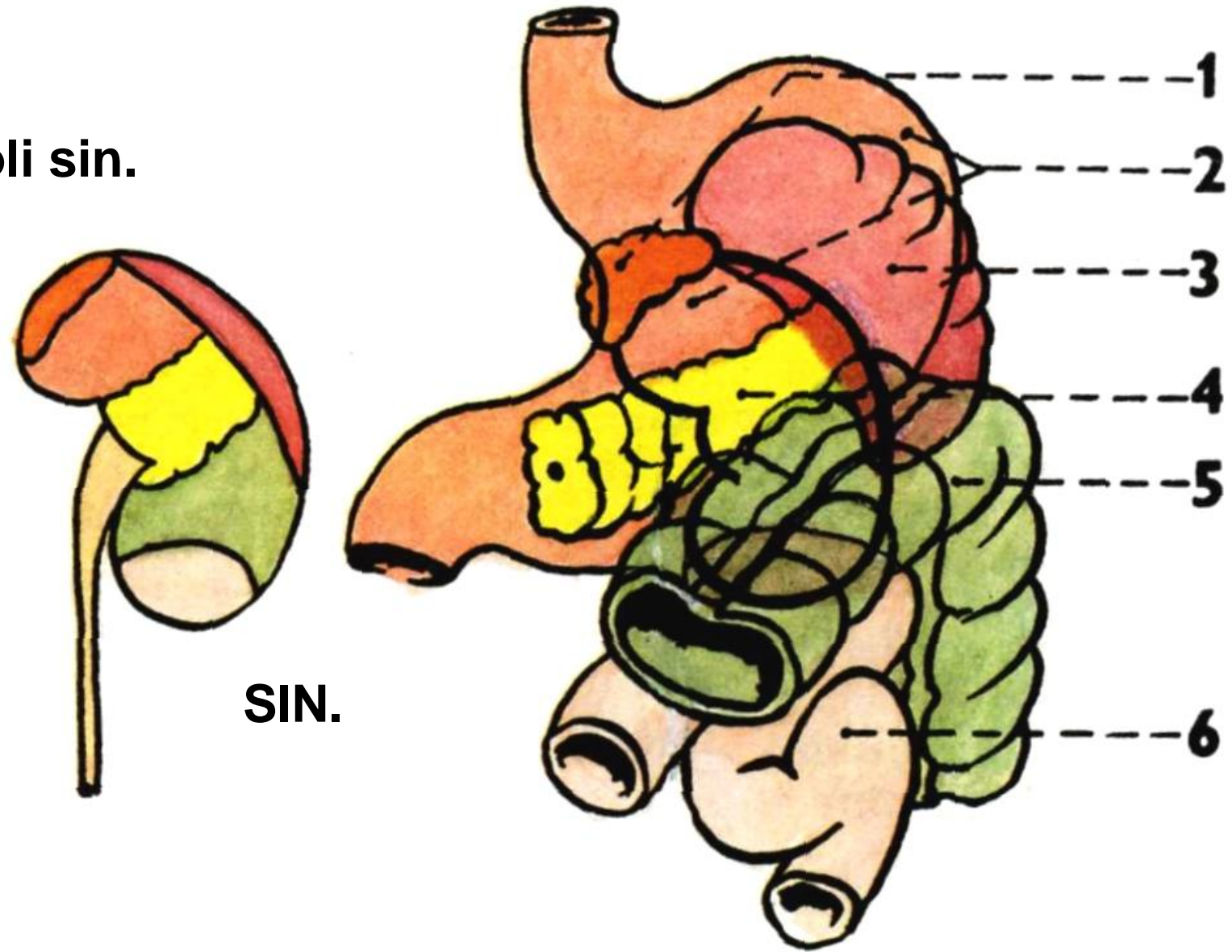


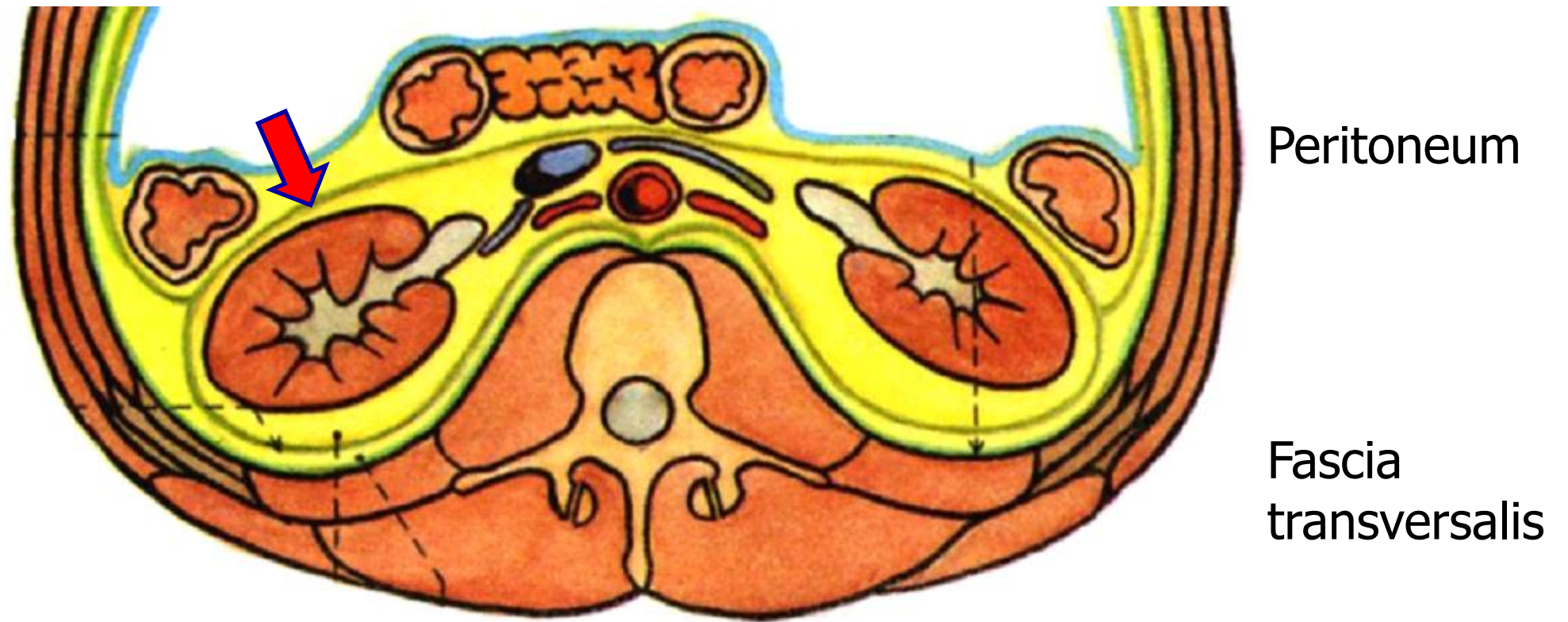
**DX.**



**DX.**

1. Gl. suprarenalis sin.
2. Stomach
3. Spleen
4. Pancreas
5. Flexura coli sin.
6. Jejunum





**Fascia renalis** ←

**I. prerenalis**

**I. retrorenalis** (fused cran. and lat.)

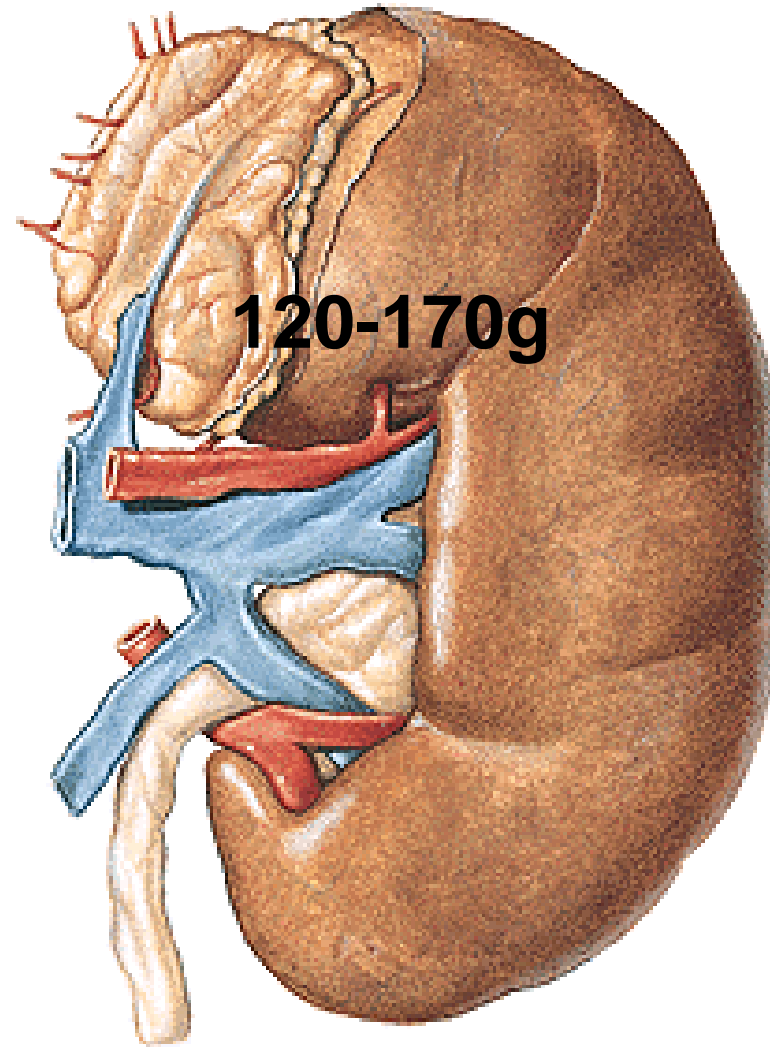
**inside: capsula adiposa (+ noradrenal gland)**

**behind: corpus adiposum pararenale**

Post.



Ant.

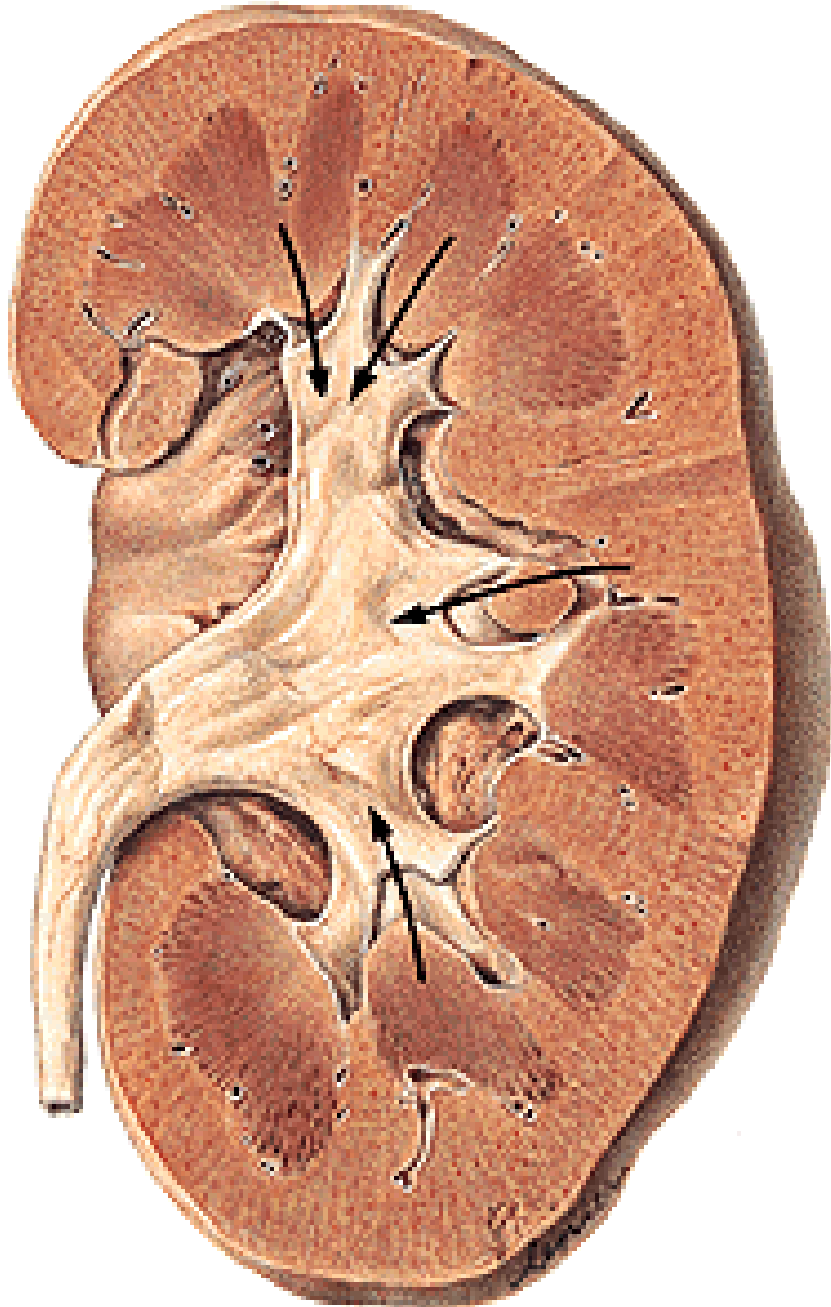


**Facies**  
anterior  
posterior

**Margo**  
lateralis  
medialis

**Hilum renale (L1)**  
**Sinus renalis**

**Extremitas**  
superior  
inferior



**Capsula fibrosa**

**Sinus renalis**

**Cortex renalis (5-8 mm)**

↓ **columnae renales**

**Medulla renalis**

↑ pars radiata cort.

**pyramides renales (6-20)**

papillae renales

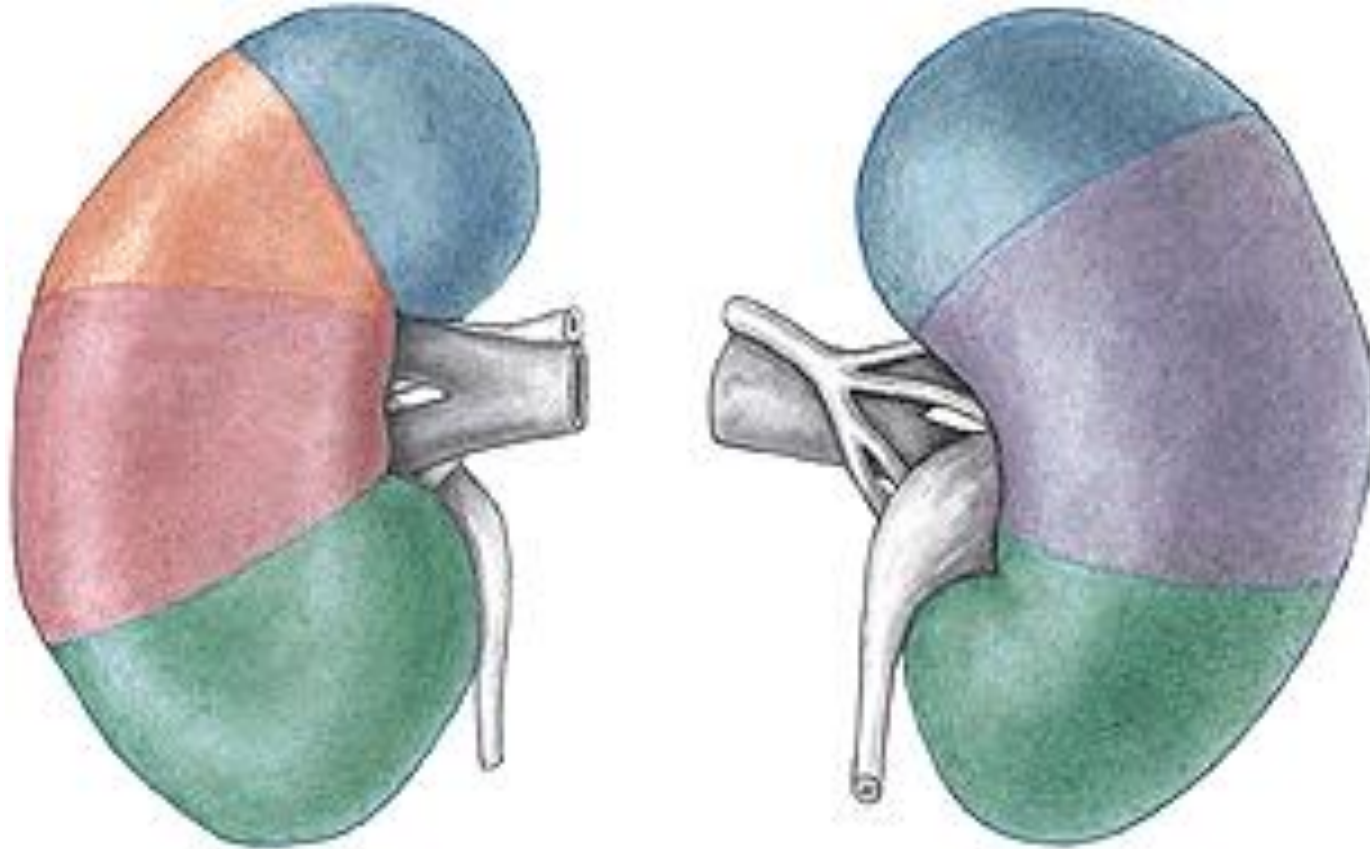
area cribrosa (ductus papillares)

**Lobi renales (6-20)**

Segments (5)

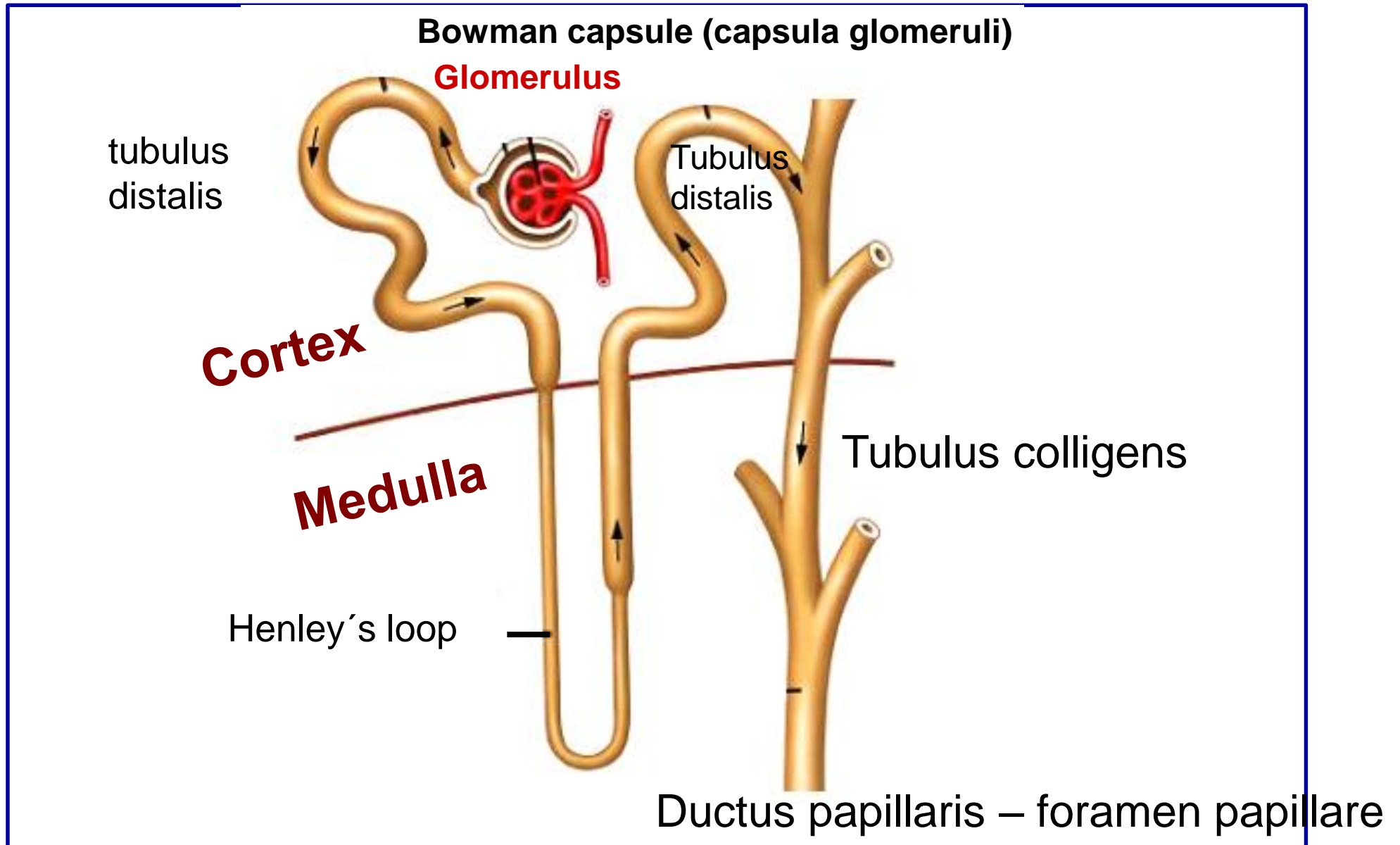
## Segmenta renalia – s. superius

- s. anterior superius
- s. anterior inferius
- s. inferius
- s. posterius



# Main functional unit - NEPHRON

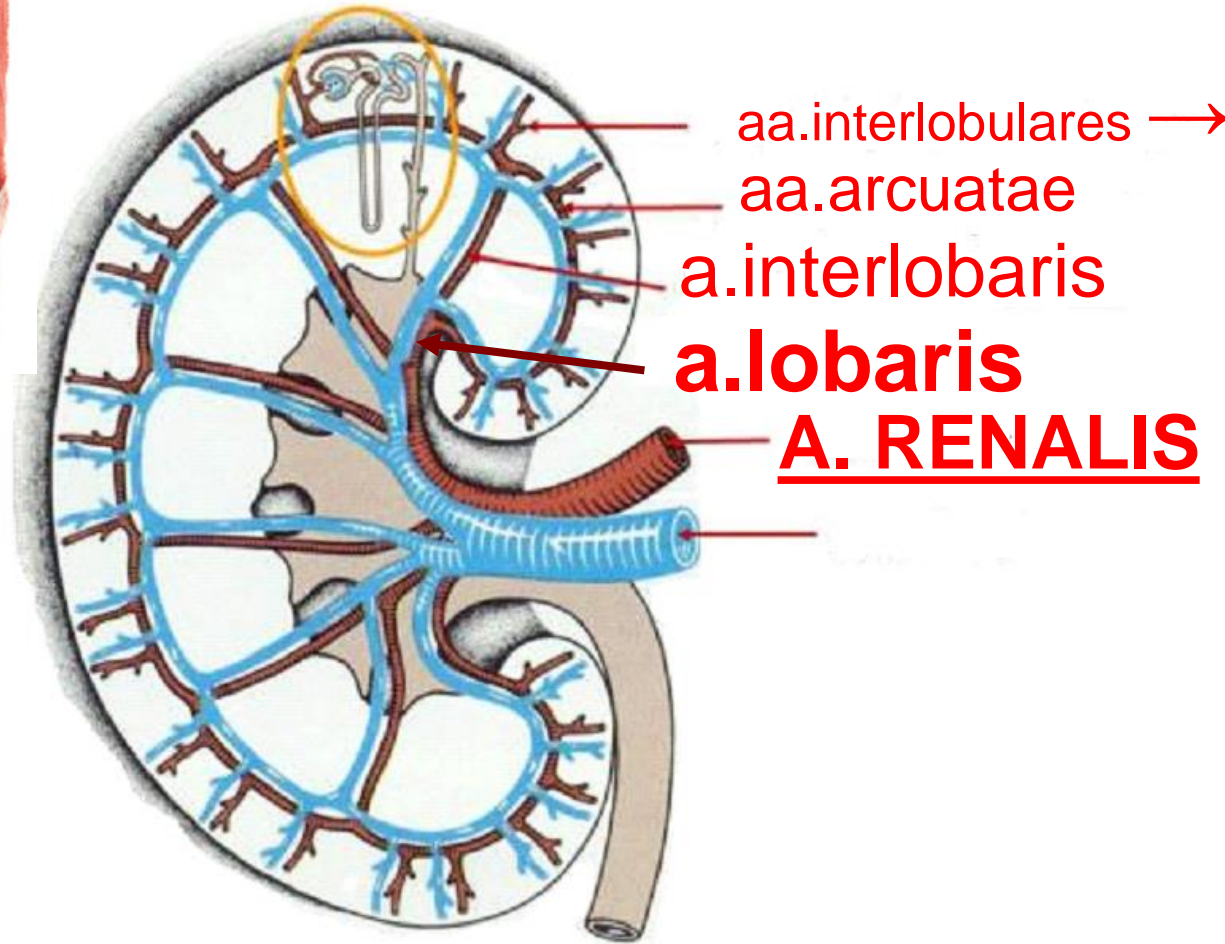
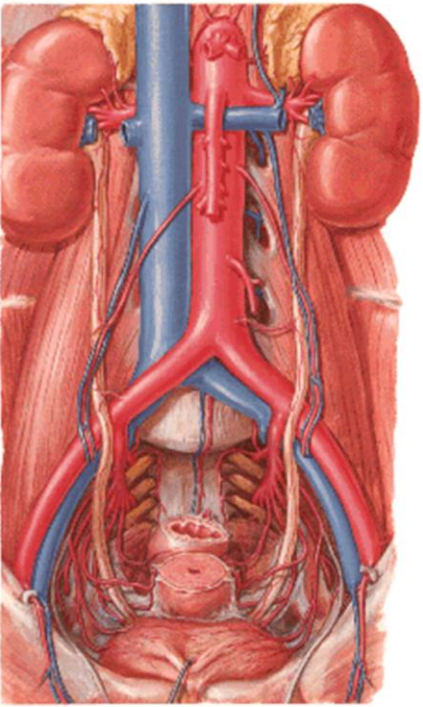
Corpusculum renale (Malpighi) + Tubuli



# A. renalis

Rr. ant. (4 rr. prepelvici)

R. post. (1 retropelvicus)



aa.interlobulares →

aa.arquatae

a.interlobaris

**a.lobaris**

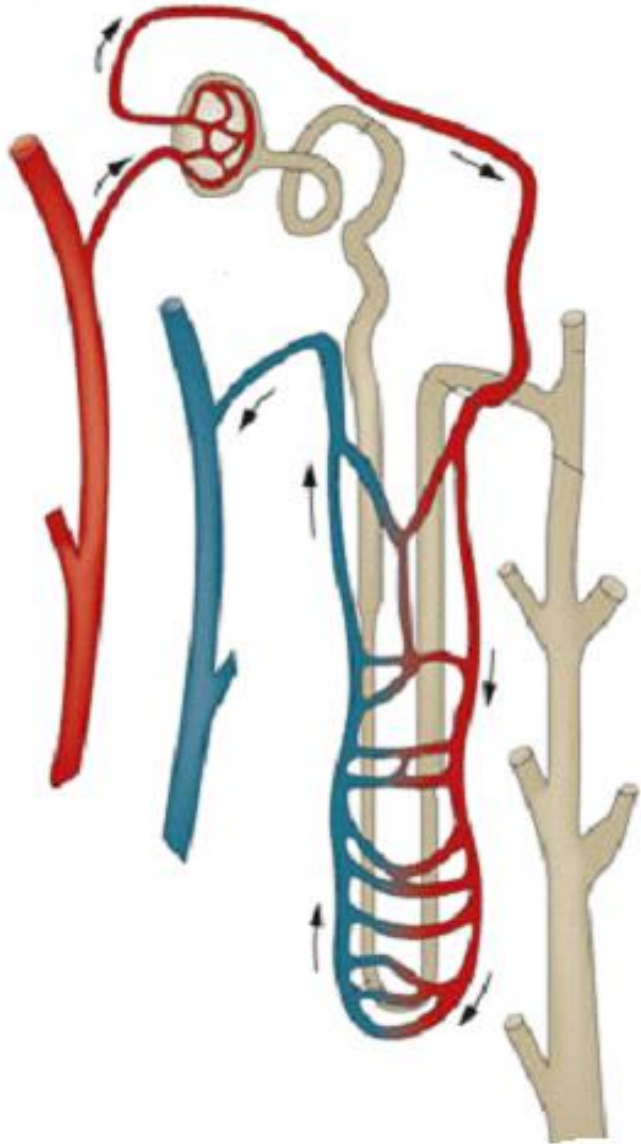
**A. RENALIS**

vas afferens  
vas efferens



Peritubular  
capillary  
plexus





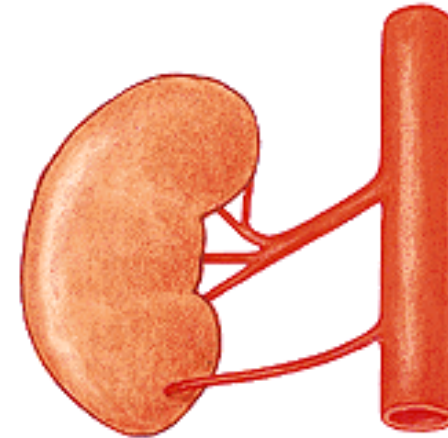
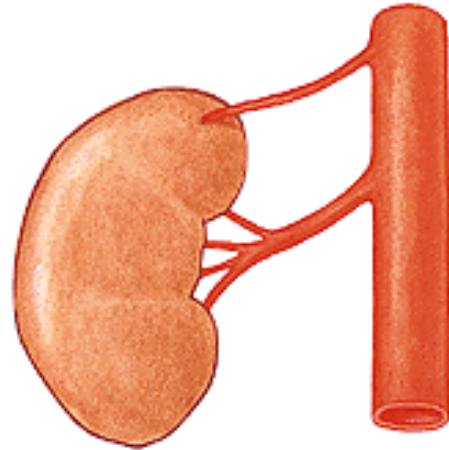
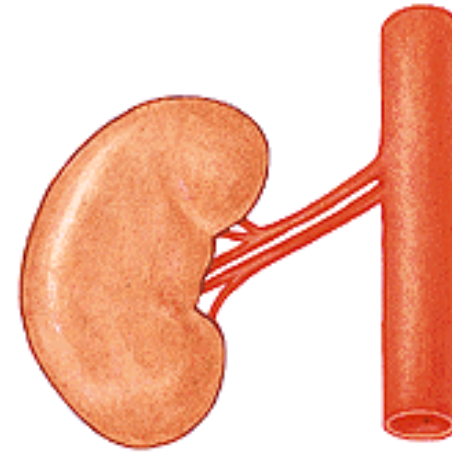
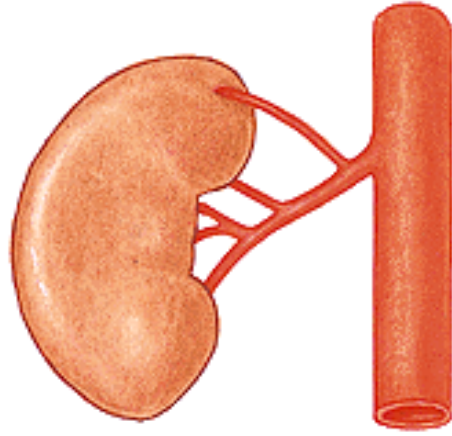
## Glomerulus

- **Glomerular filtration → primary urine- 170-200 l**

## Peritubular plexuses

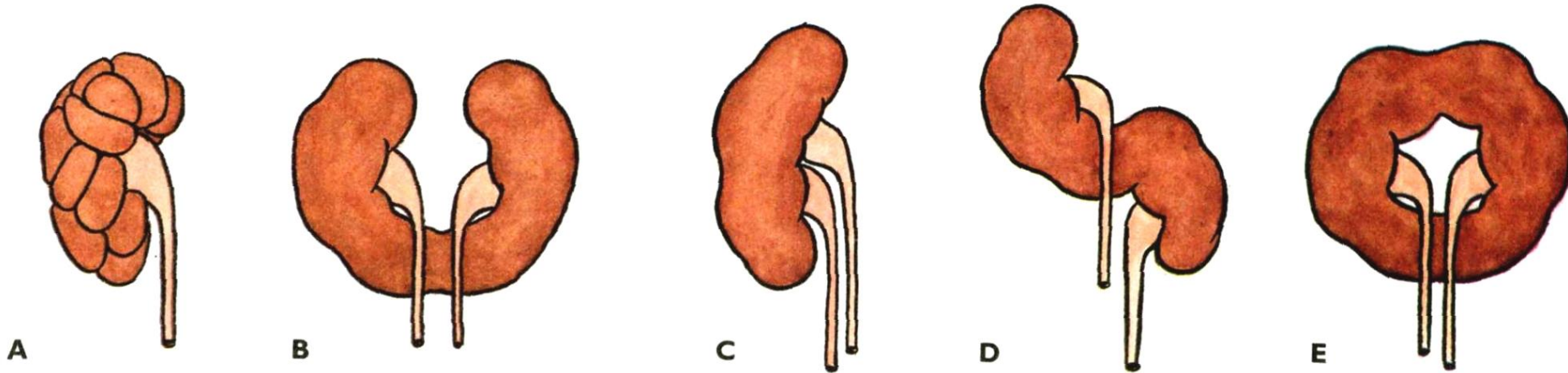
- **Reabsorption of water and substances from filtrate to the blood**
- **Secretion of ions and substances from the blood to the urine → define urine 1-1,5 l**

## Aa. renales accessoriae



- renculi marking
- ren arcuatus
- ren duplex
- ren sigmoideus
- ren fungiformis
- agenesia renis

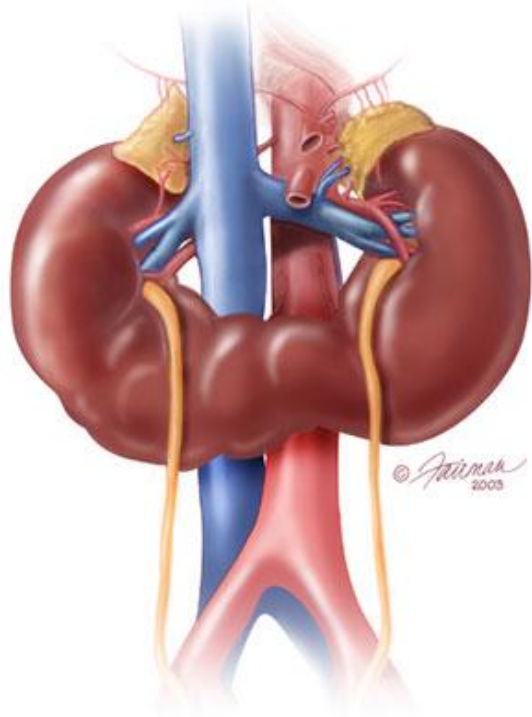
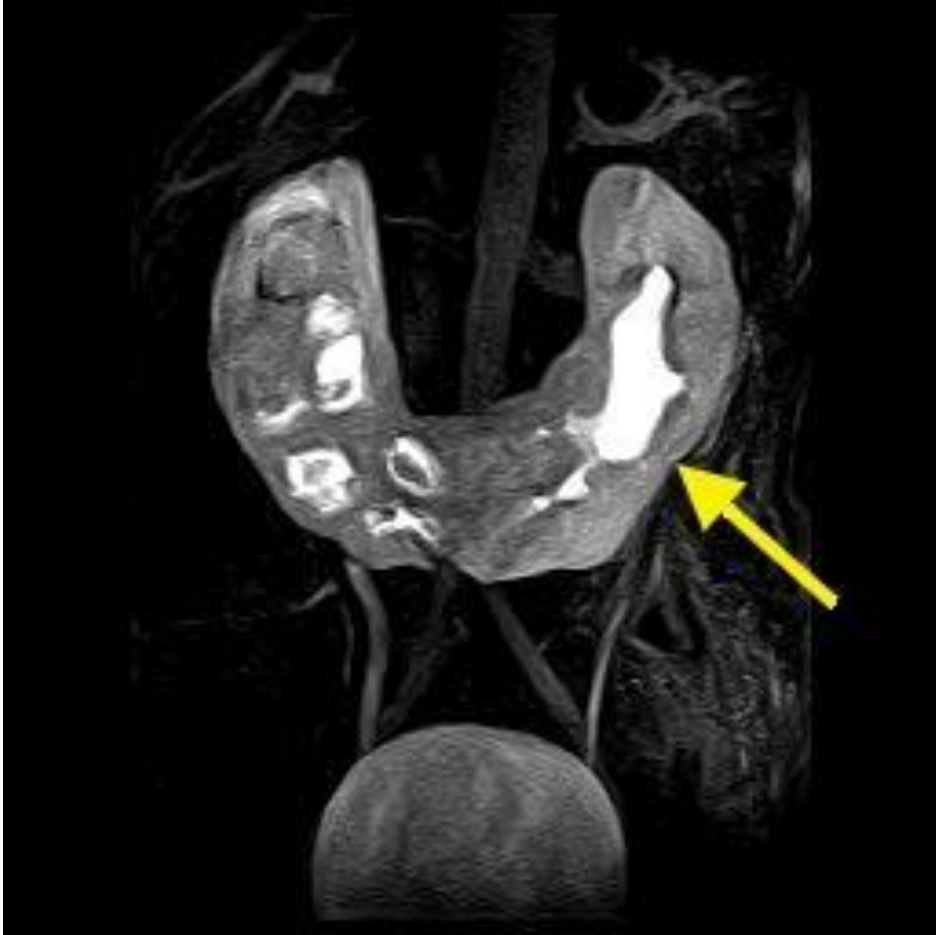
## VARIATIONS



# Ectopic kidney x Ren migrans



# Horseshoe kidney



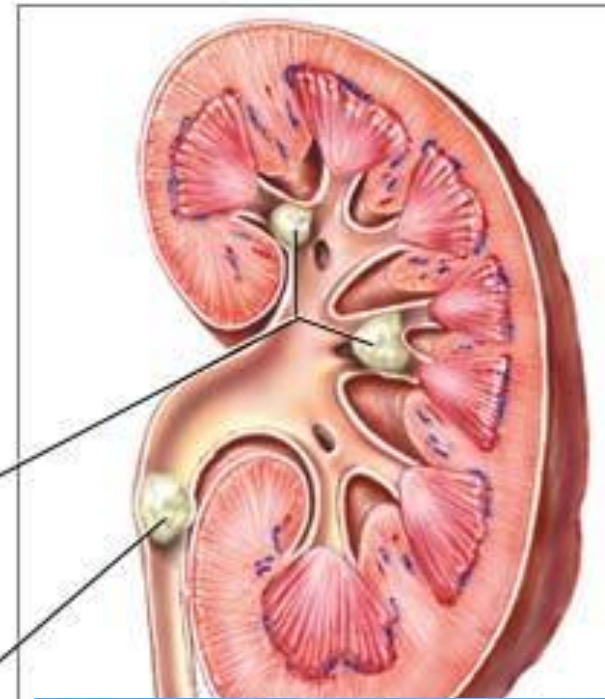
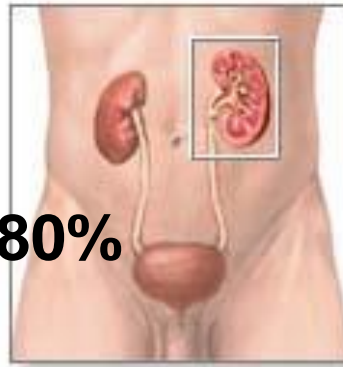


**Cross-sectional image through the L1 obtained with CT**

# Nephrolithiasis

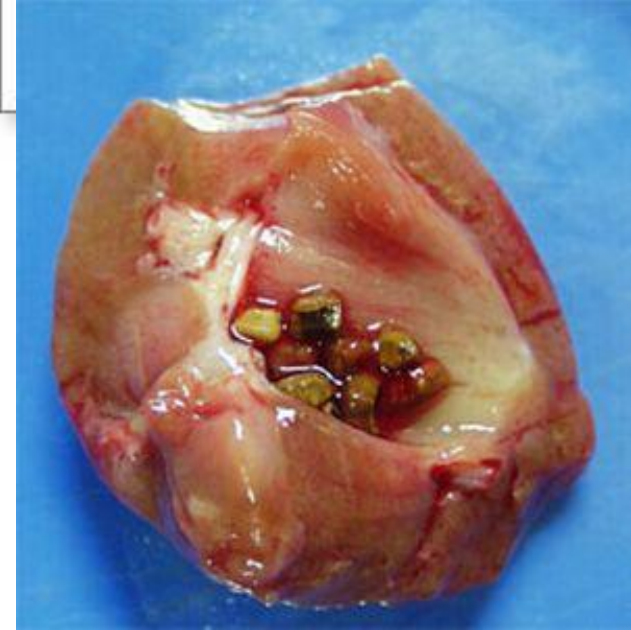
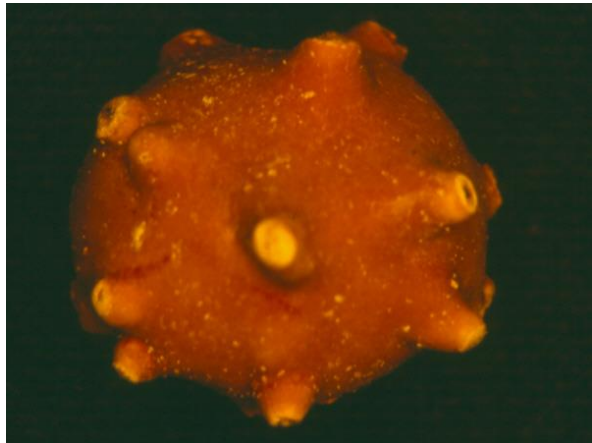
**Calcium oxalate crystals – 80%**

**Uric acid – 5 - 10%**

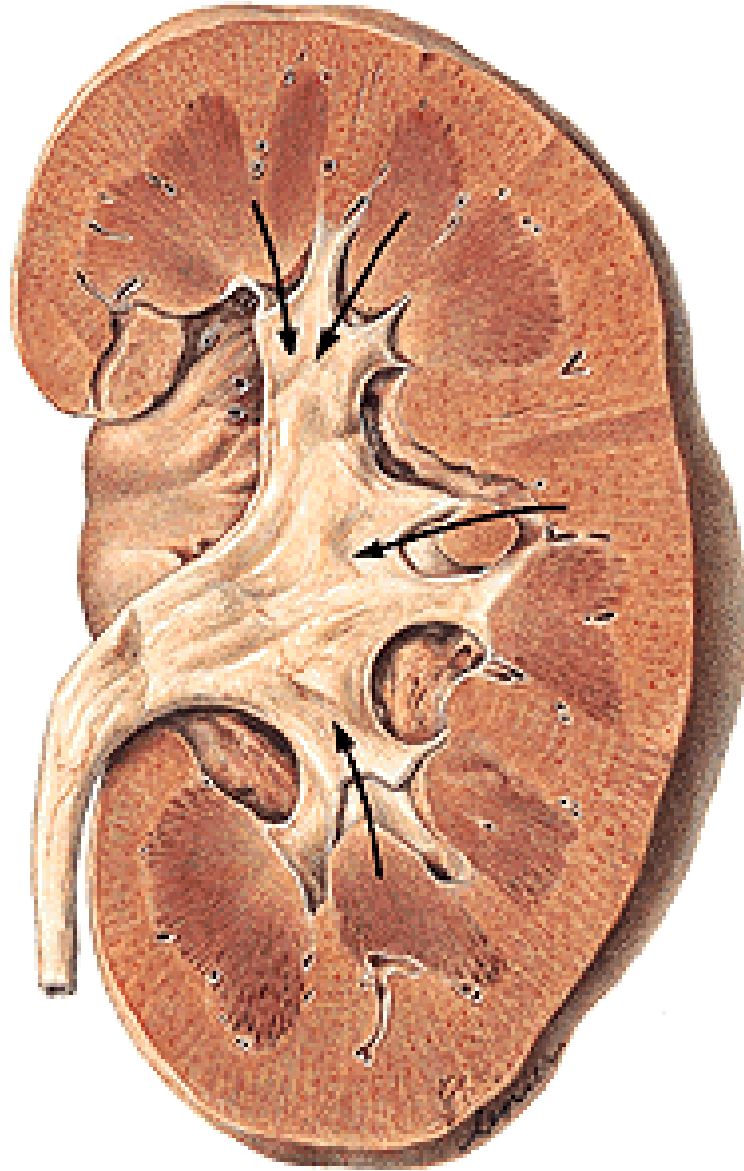


Kidney stones in the minor and major calyces of the kidney

Kidney stone in the ureter

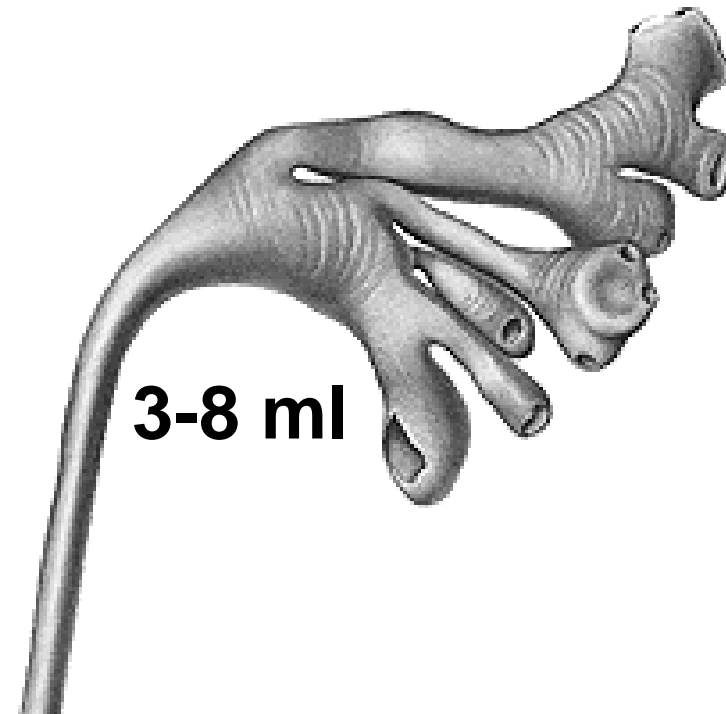


# Excretory urinary tract

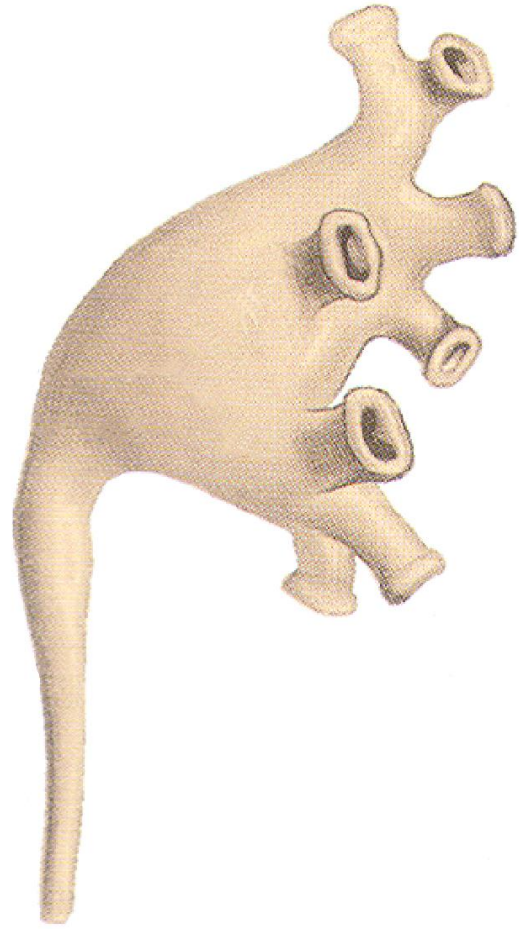


**Calices renales**  
minores 7-12  
maiores 3-4

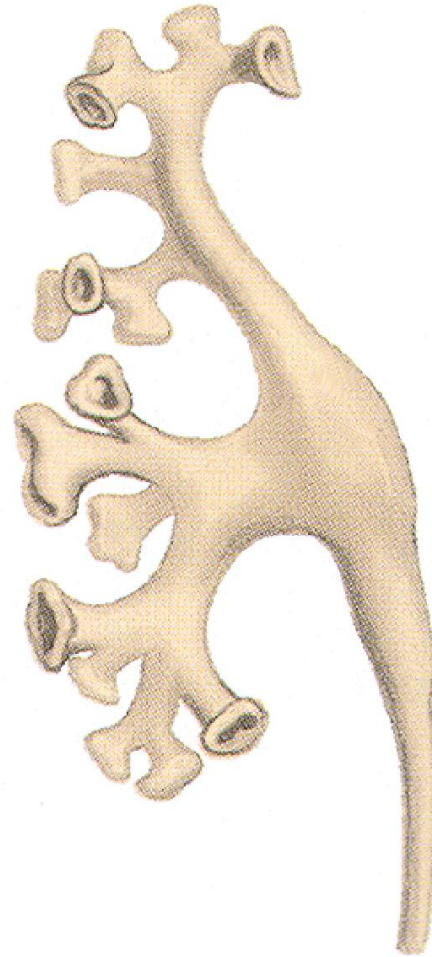
**Pelvis renalis**



**3-8 ml**



**ampular**



**dendritic**



# Ureter 25-30cm

**syntopy**

**Parts**

abdominalis

pelvina

intramuralis - **ostium**

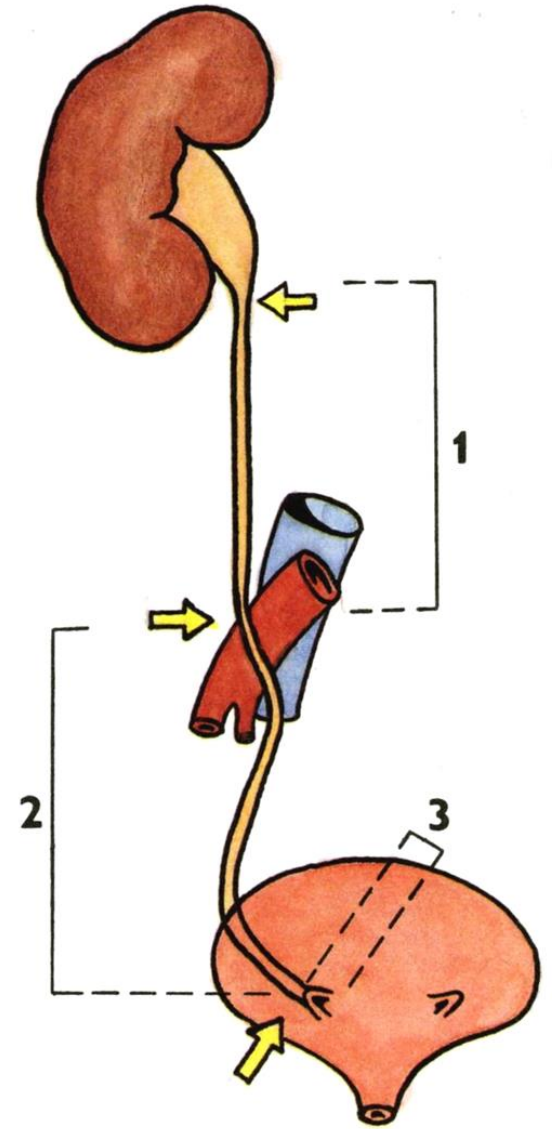
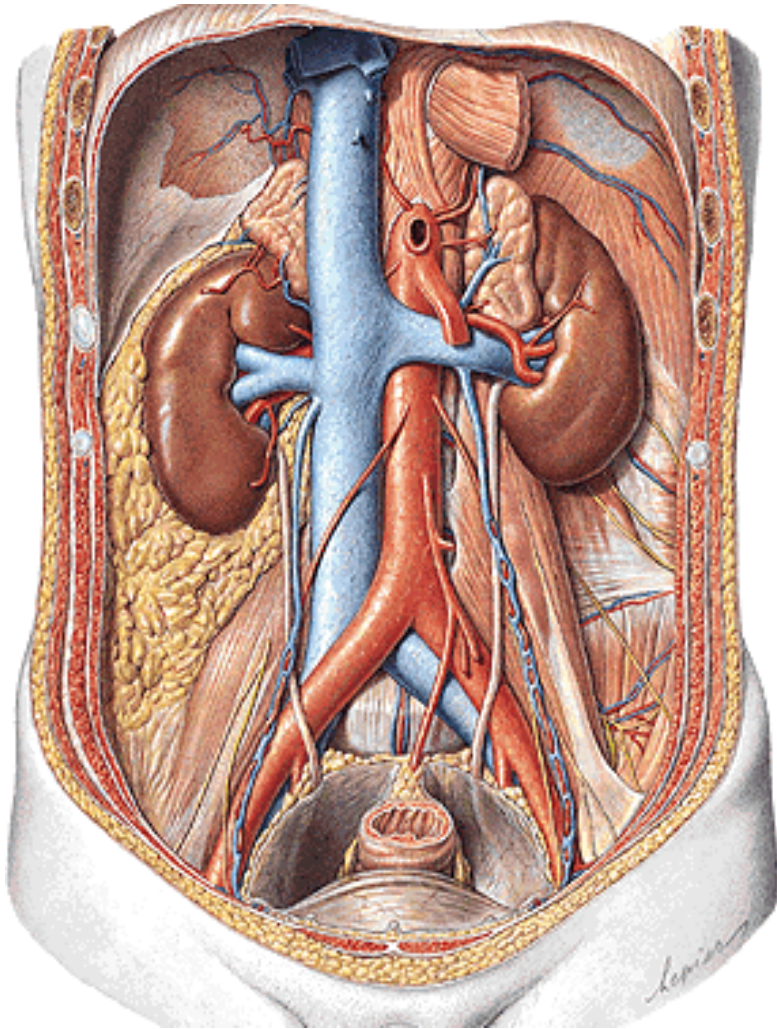
**ureteris**

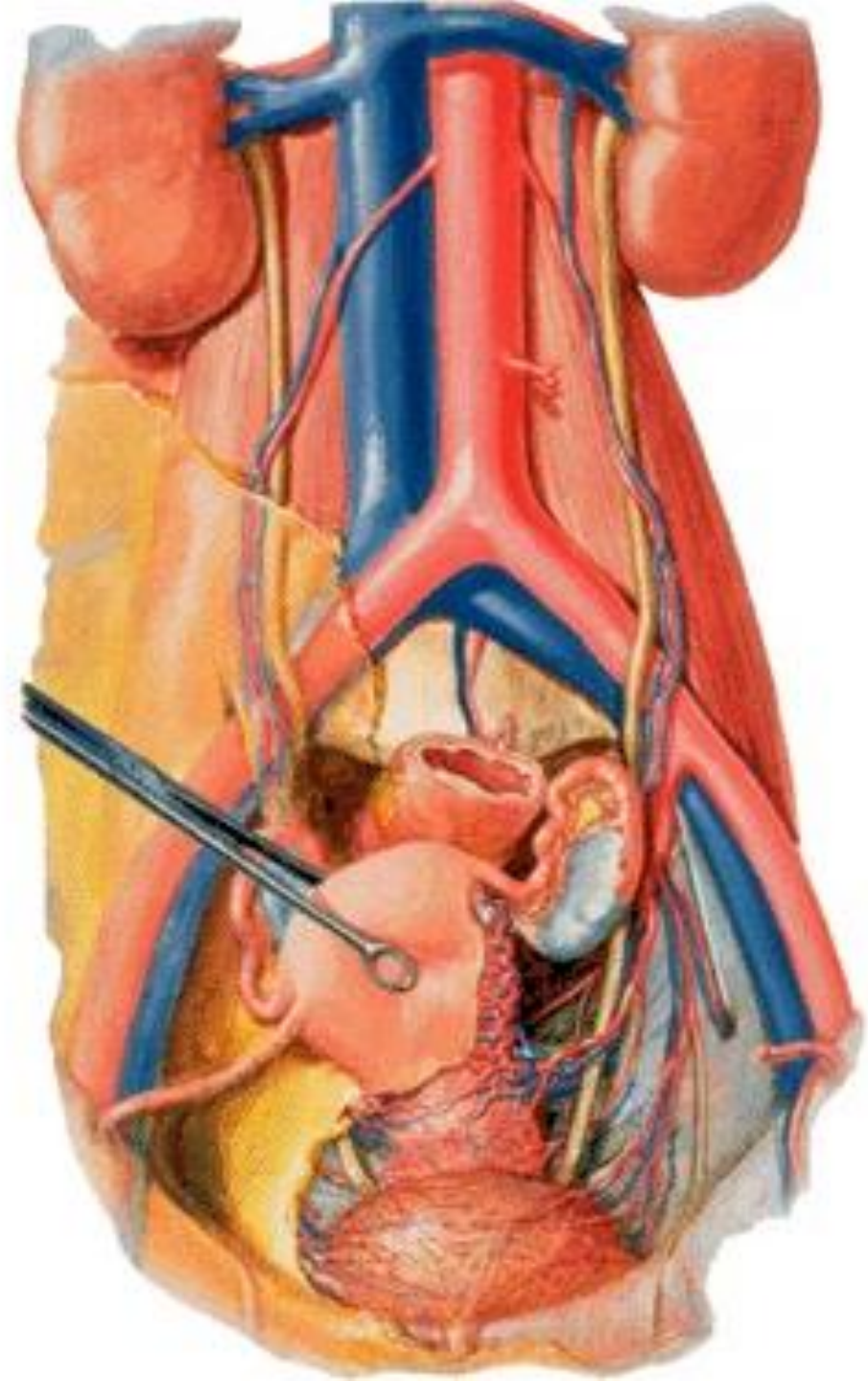
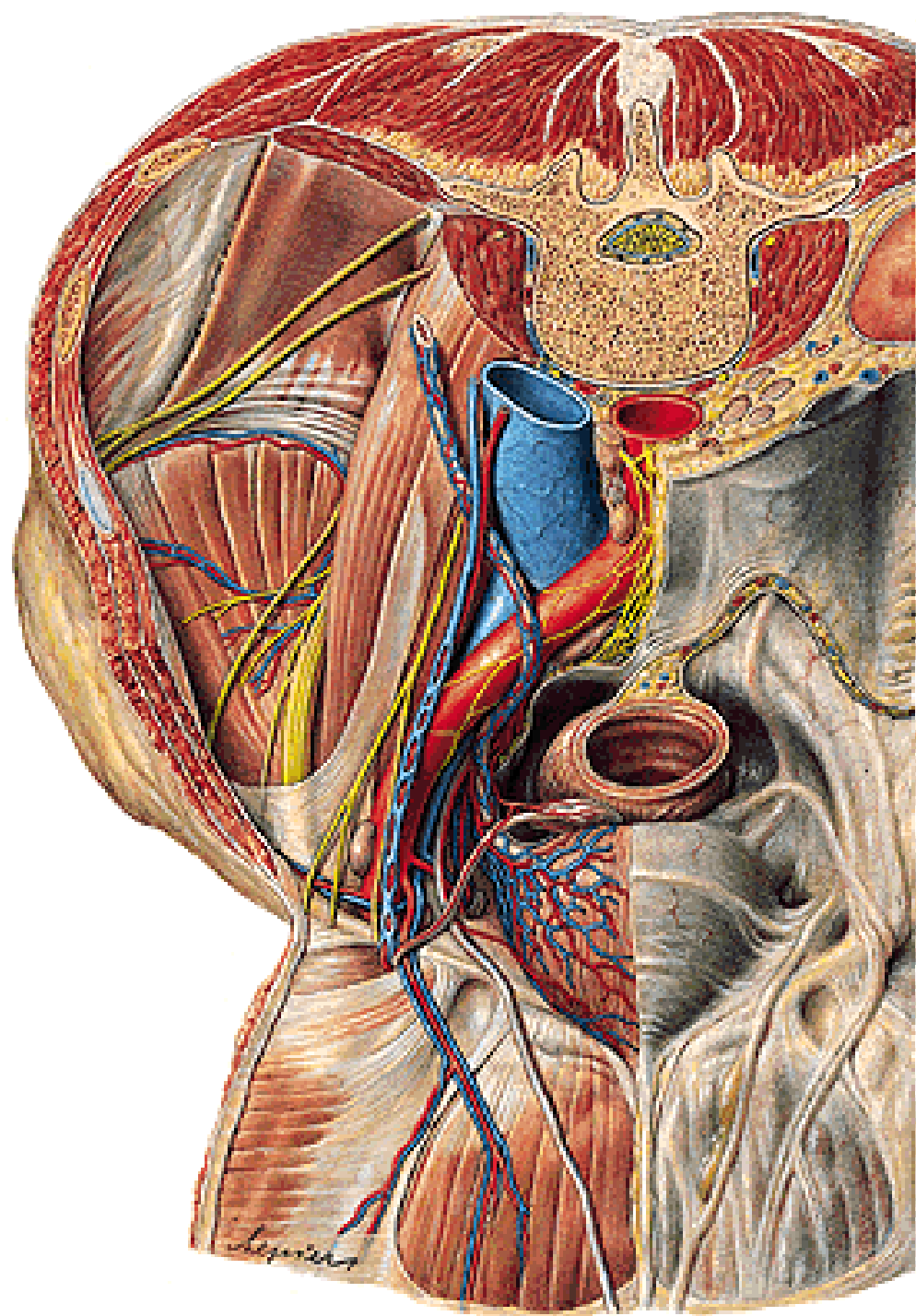
**Crossed by**

a.v. test. / ovarica

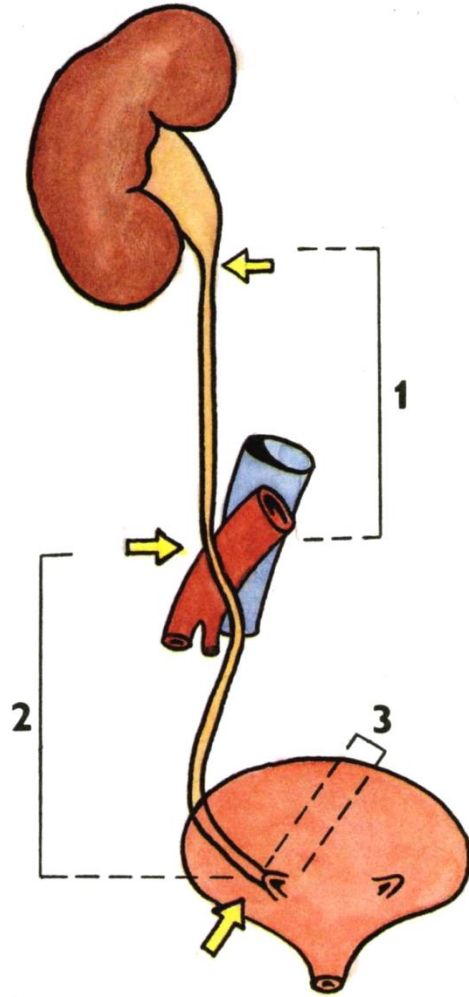
a.v. iliaca comm

dct. def. / a. uterina

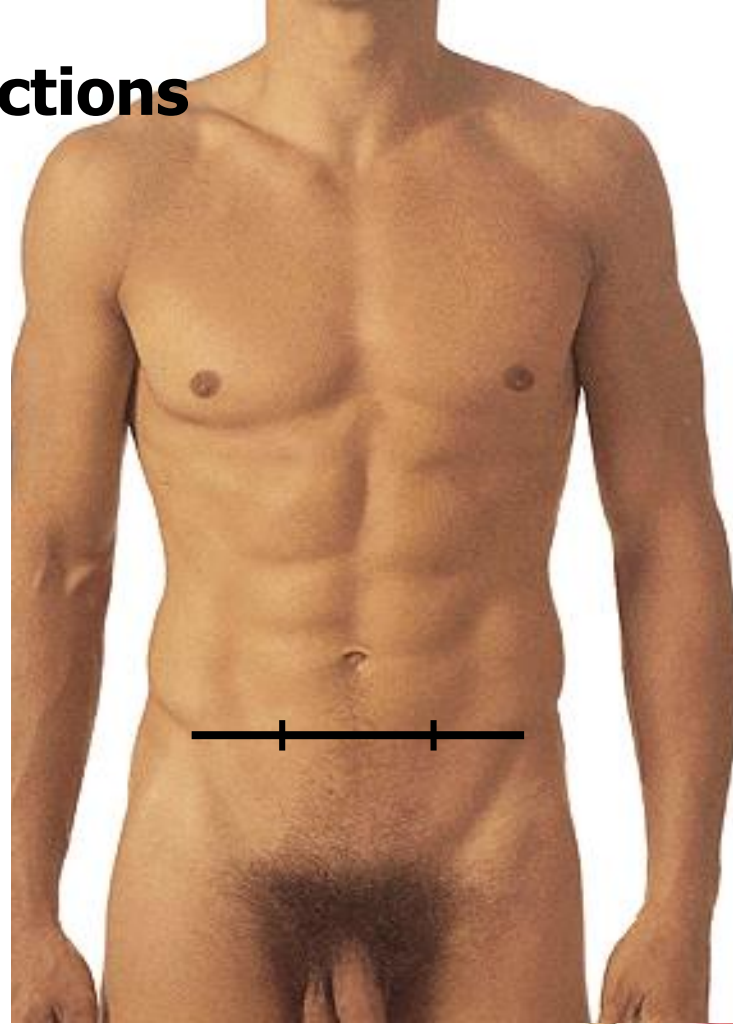




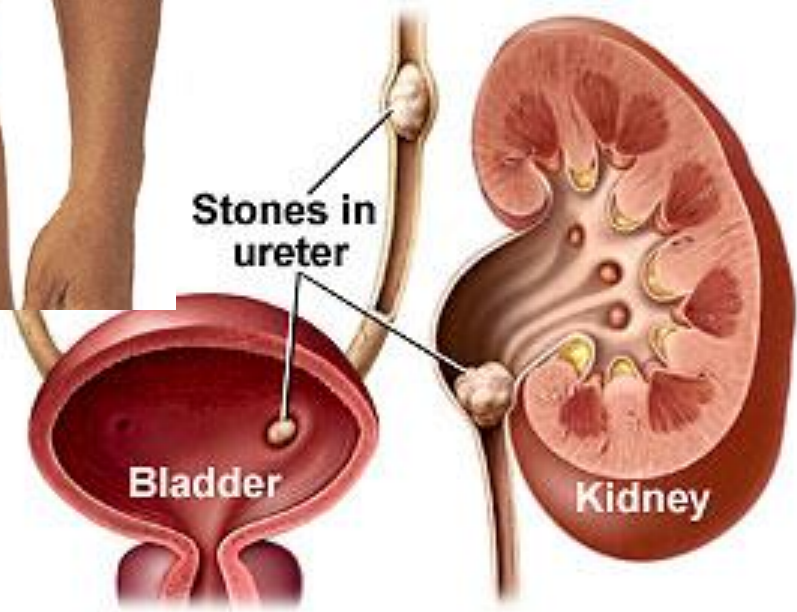
### 3 physiological constrictions

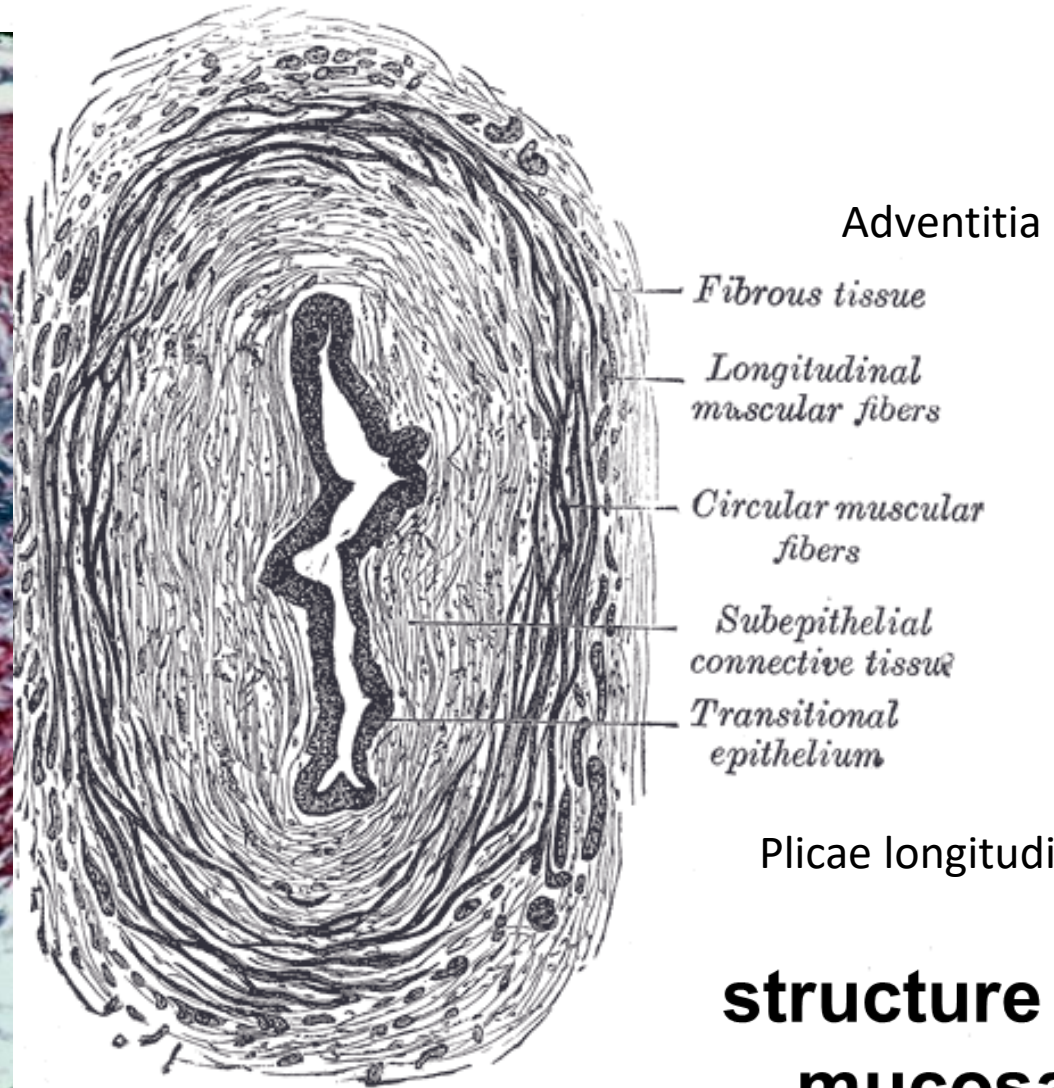


Sinus renalis  
linea terminalis  
pars intramuralis



**Ureteric point**





Adventitia

*Fibrous tissue*

*Longitudinal  
muscular fibers*

*Circular muscular  
fibers*

*Subepithelial  
connective tissue*

*Transitional  
epithelium*

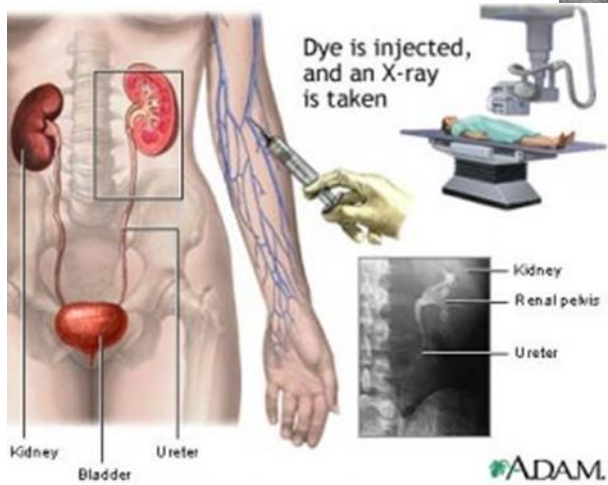
Plicae longitudinales

**structure**

**mucosa**

**musculature**

**adventitia**



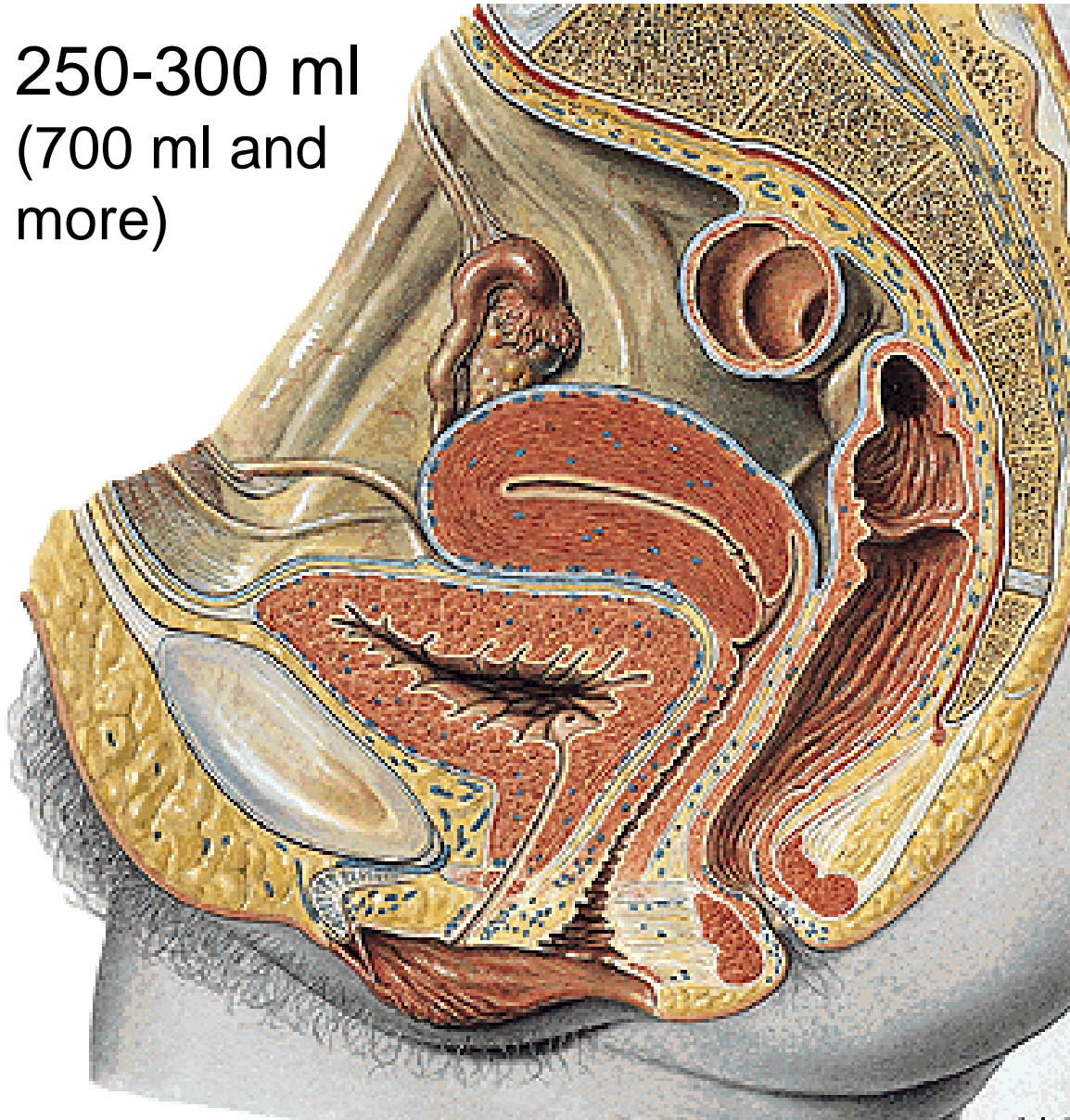
**Intravenous urography**



**Retrograde pyelography**

# Vesica urinaria

250-300 ml  
(700 ml and  
more)



## Localisation

## Parts

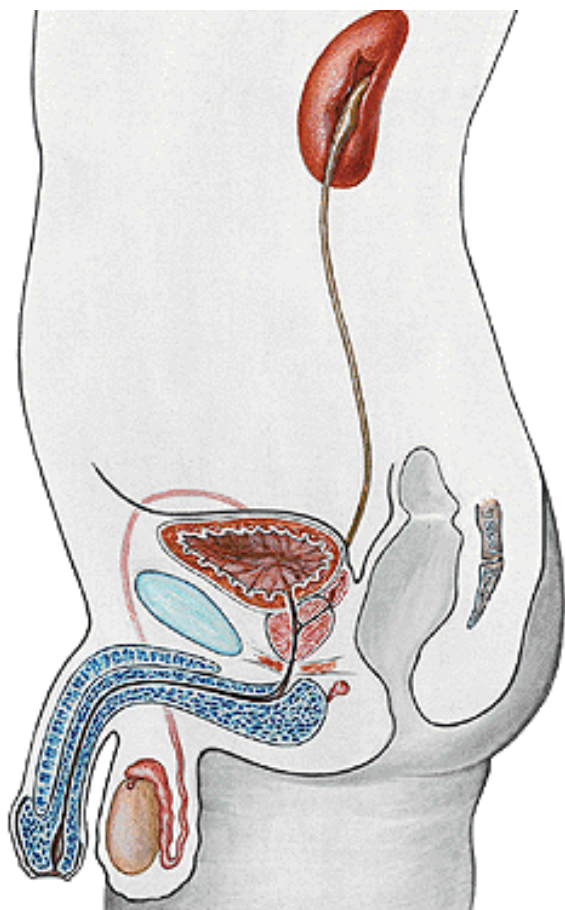
**apex vesicae** →  
lig. umbilicale med.  
**corpus**  
**fundus**  
cervix → urethra.

## structure

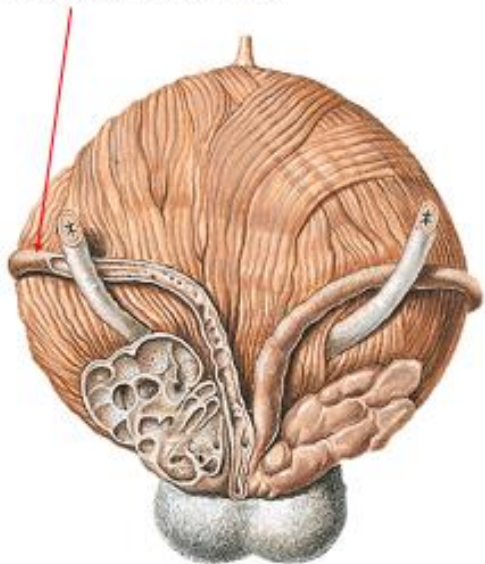
**Mucosa**

**Musculature**

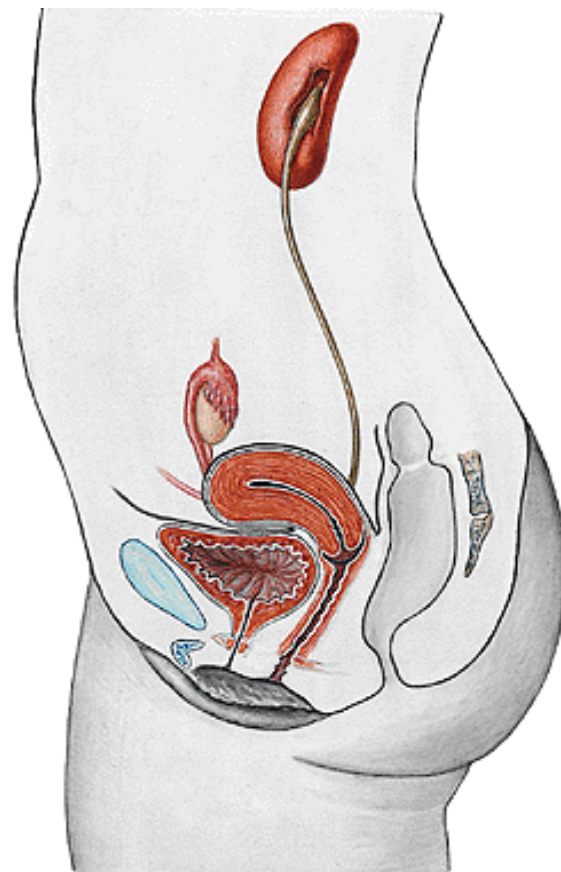
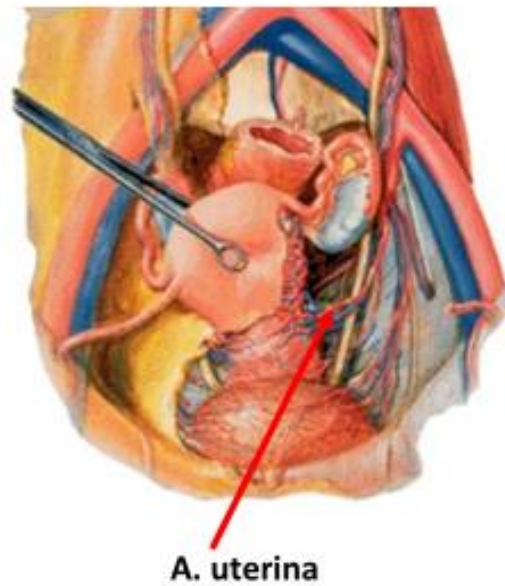
**Adventitia**



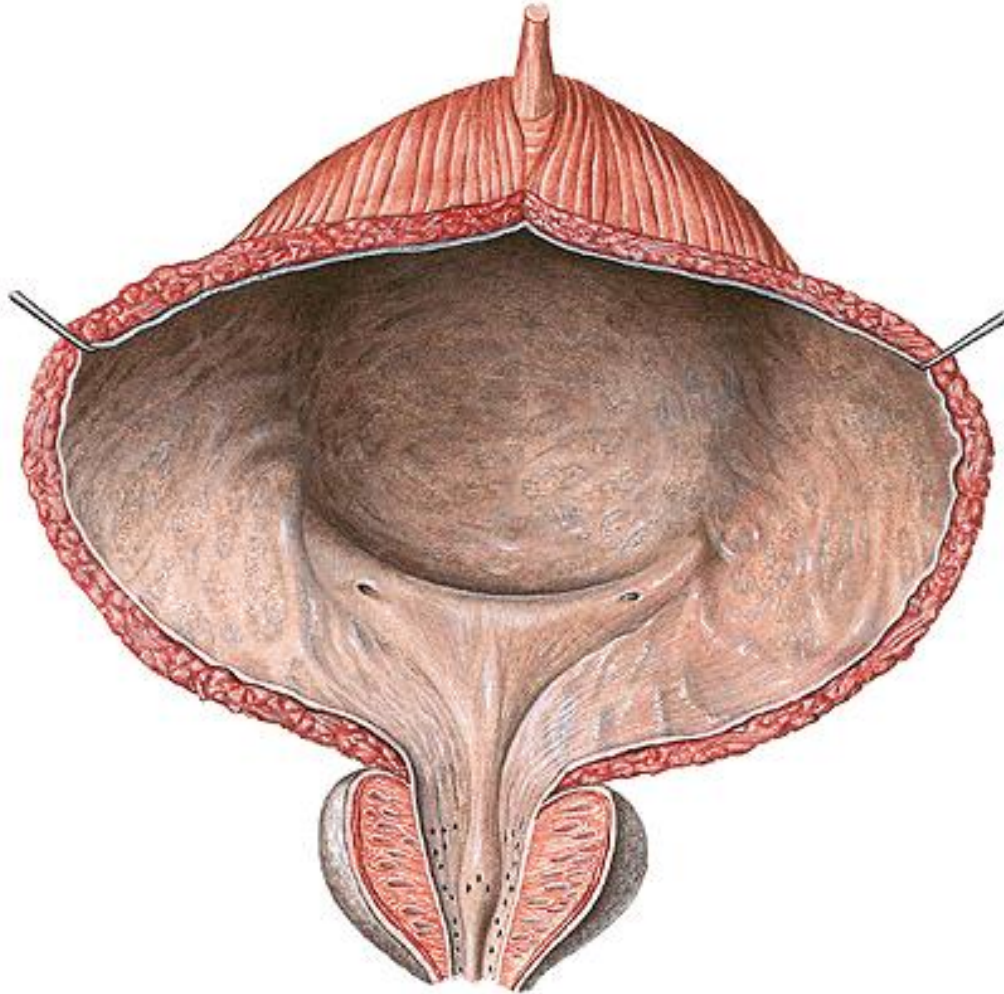
Male - dorsal aspect of urinary bladder  
Ductus deferens



Female – anterosuperior aspect



# Mucosa – fundus vesicae



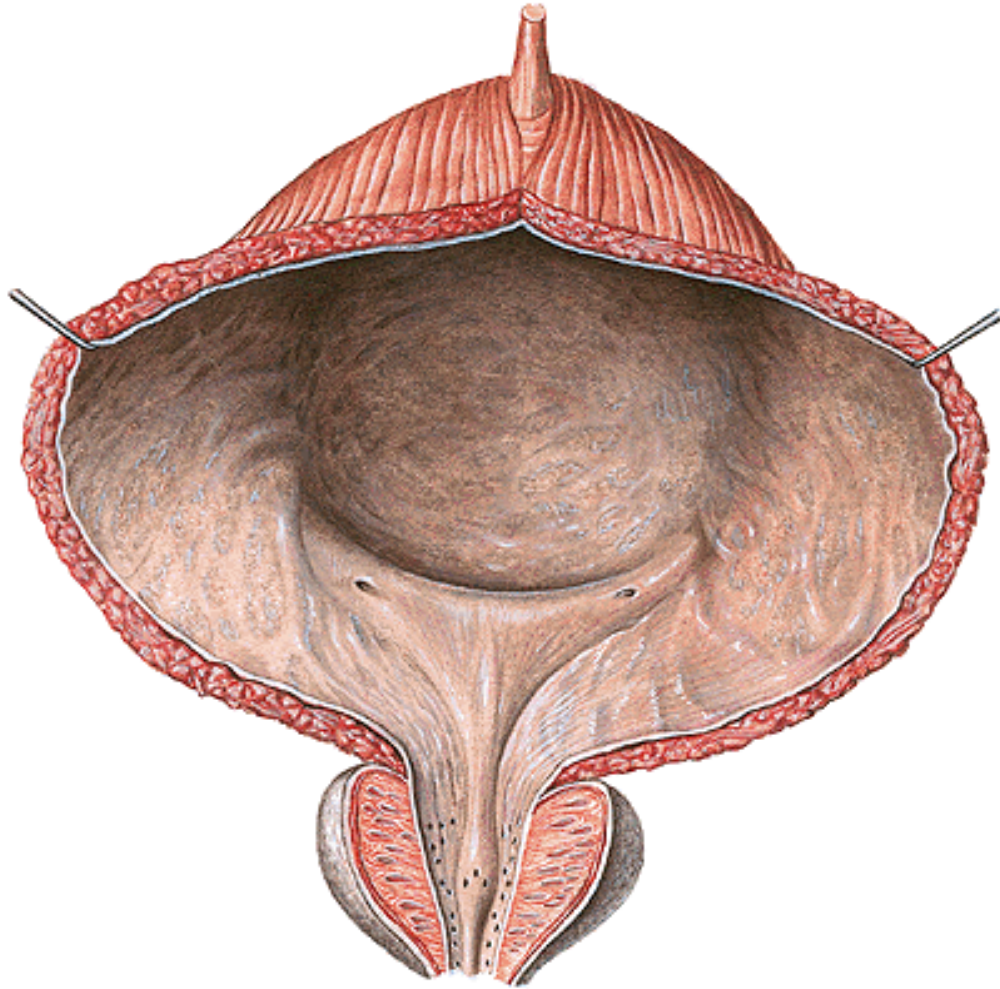
## Trigonum vesicae

Ostia ureterum

Ostium urethrae int.

- ✓ Mucosa without folds
  - ✓ plica interureterica
  - ✓ fossa retrotrigonalis
  - ✓ uvula vesicae  
(♂ lobus medius  
of the prostate)
- m. detrusor





**Submucose tissue**  
**sparse** (no in trig. vesicae)

**musculature**

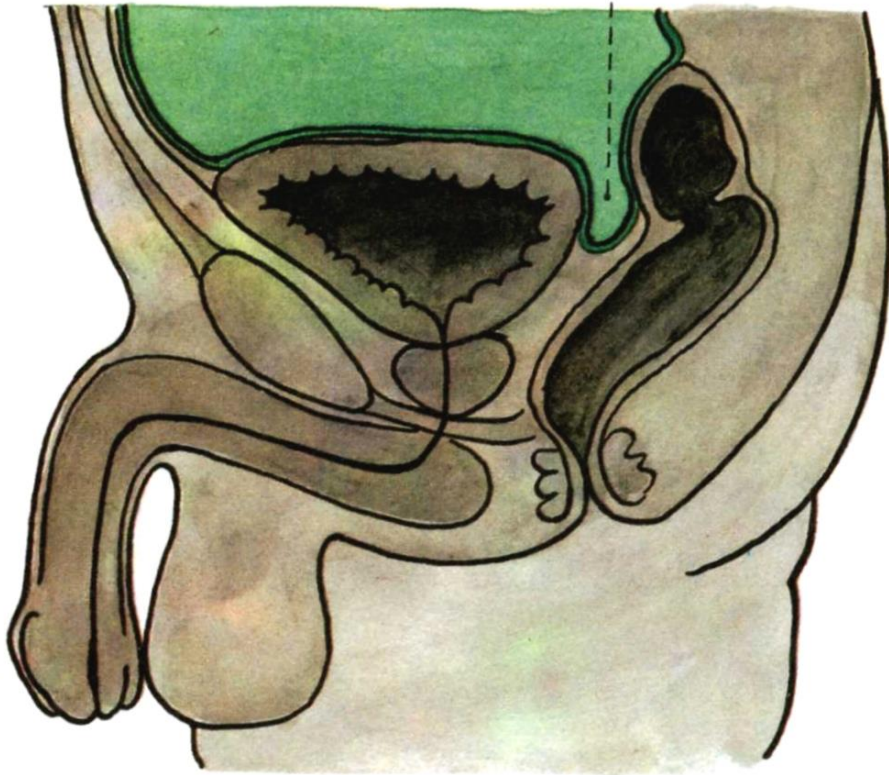
reticular (internal)  
circular (m. sphincter  
vesicae et urethrae –  
Smooth muscle)  
longitudinal (external)

**Adventitia**

paracystium

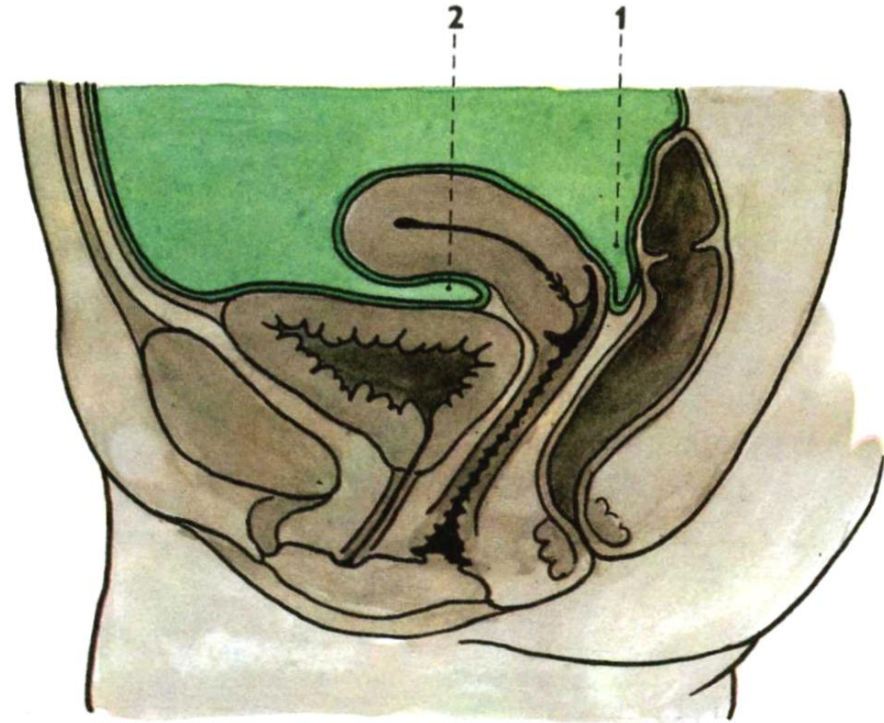
## Median section through the male pelvis

1. Excavatio rectovesicalis



## Median section through the female pelvis

1. Excavatio rectouterina
2. Excavatio vesicouterina



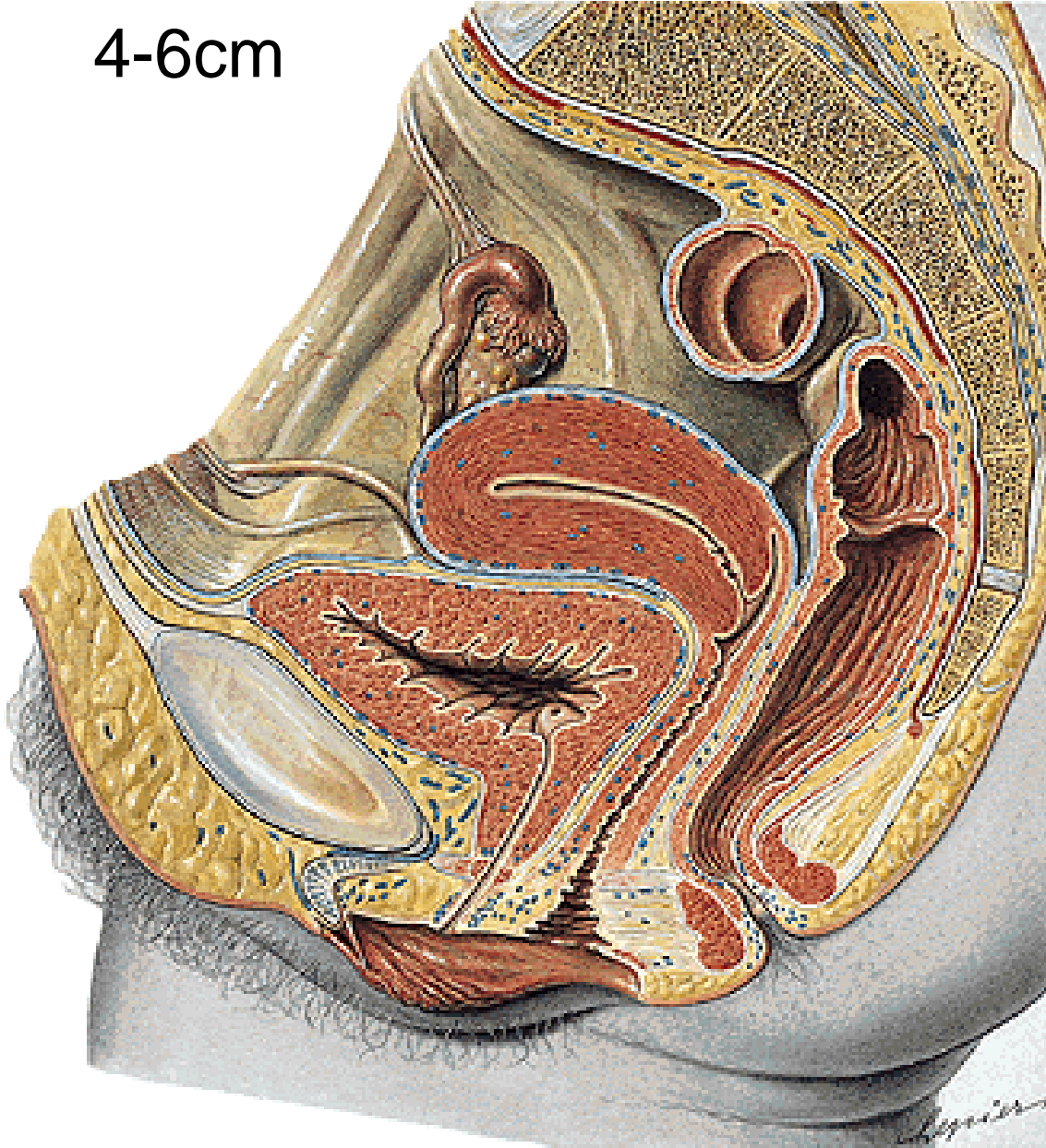
**Paracystium**

# Cystography



# Urethra feminina

4-6cm

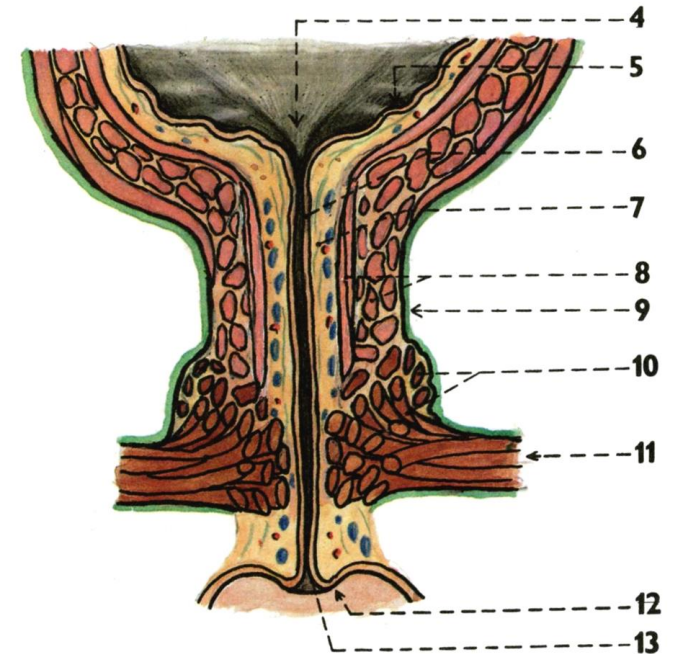


## Localisation

**Ostium urethrae internum**  
**M. sphincter urethrae**  
**Ostium urethrae externum**

## pars

intramuralis  
diaphragmatica  
perinealis





**Ostium urethrae  
externum**  
(papilla urethralis)

## **mucosa**

- crista urethralis
- lacunae urethrales - gl.  
urethrales, ductus  
paraurethrales
- Transitional epithelium

## **muscle**

smooth

striated- m. sph. urethrae  
fibers from the muscles of the  
pelvic floor

## **Adventitia**

# **MALE GENITAL ORGANS (ORGANA GENITALIA MASCULINA)**

**Organa genitalia interna:**

**Testis**

**Epididymis**

**Ductus deferens**

**Urethra masculina**

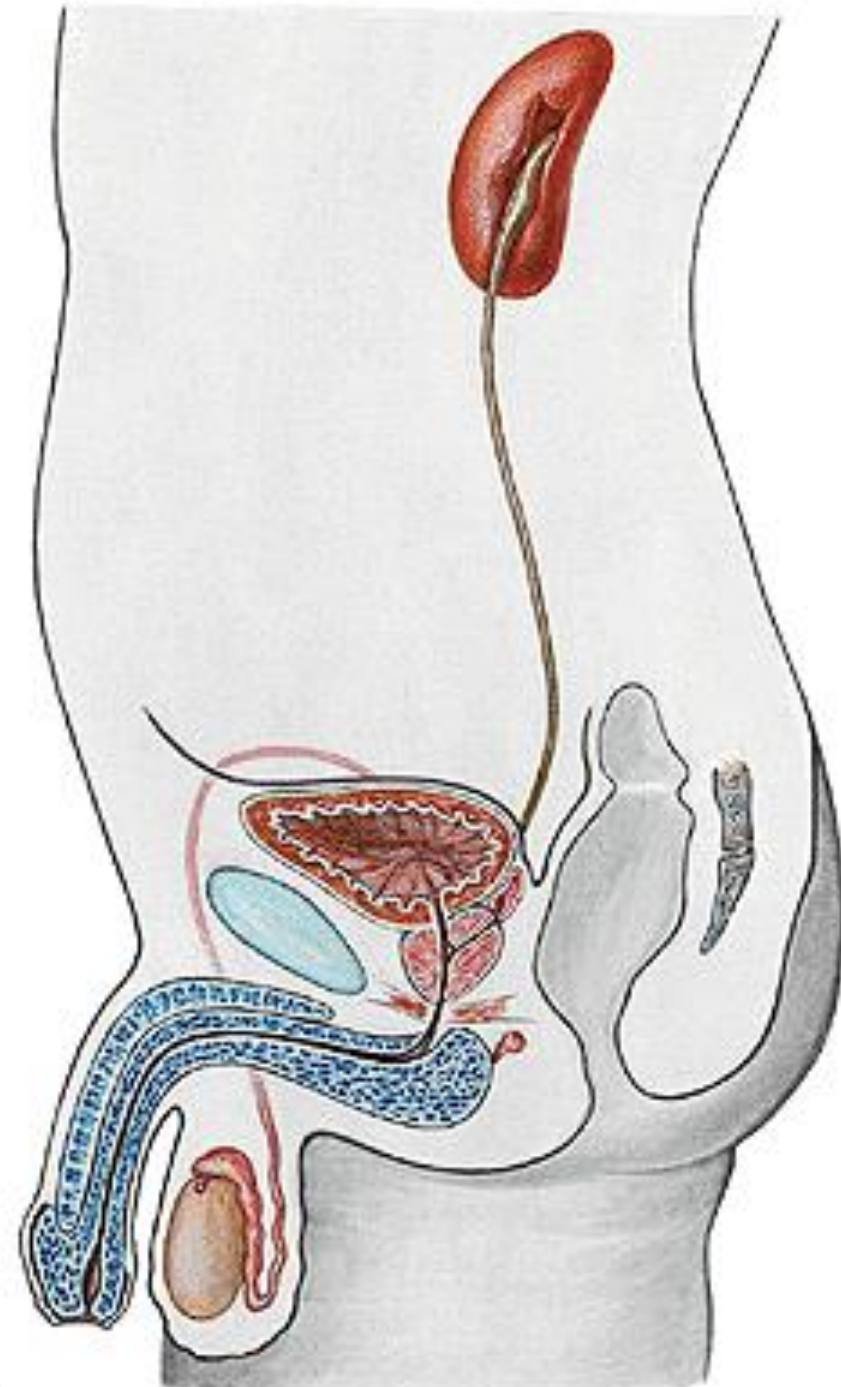
**Vesicula seminalis**

**Prostata**

**Organa genitalia externa:**

**Penis**

**Scrotum**





## Testes

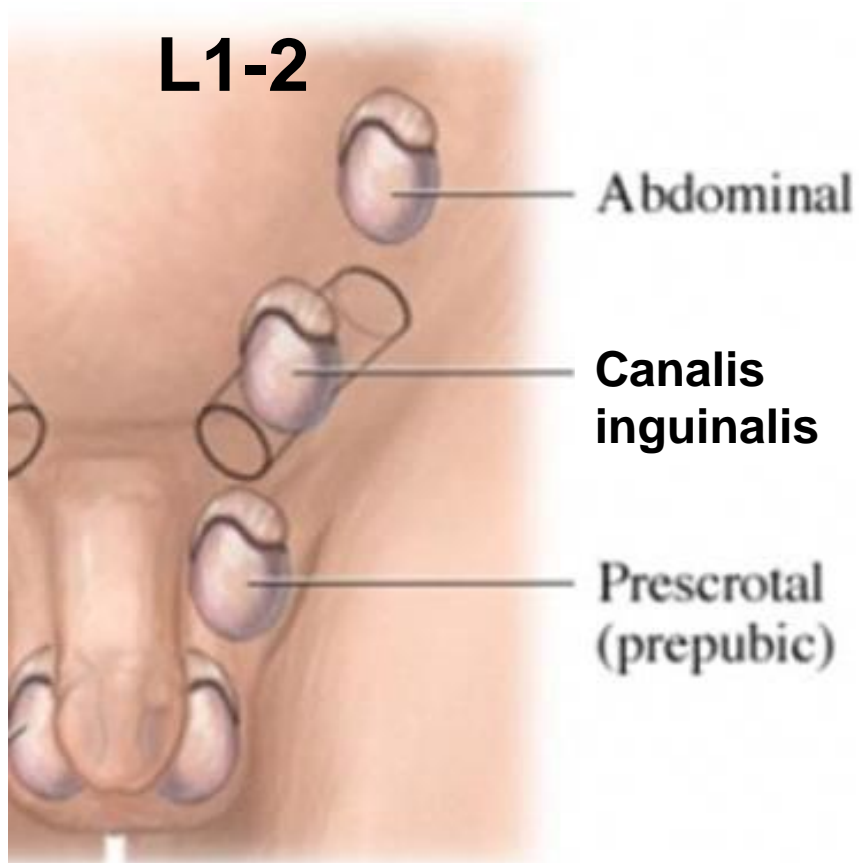
Production of sperm  
endocrine function  
(testosterone)

## Epididymis

„storage“ of sperm



# Descensus of the testes and epididymis

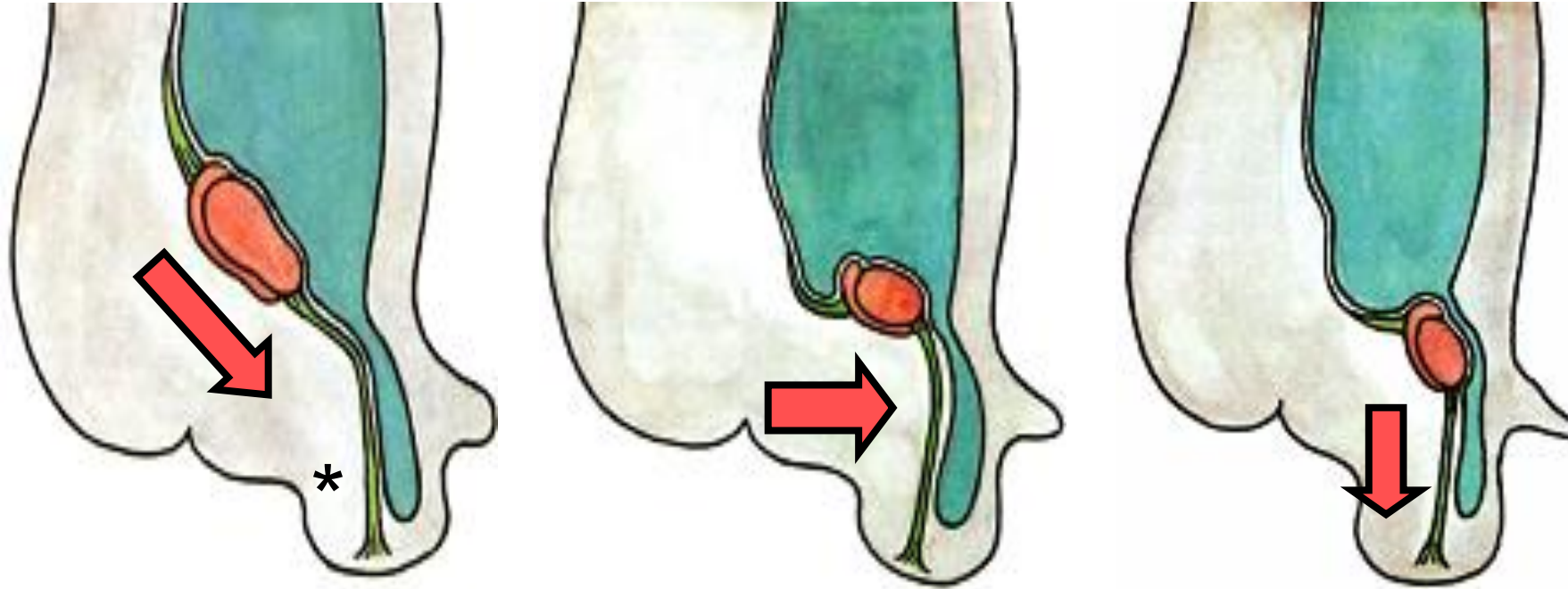


**Preliminary position:  
abdominal cavity  
Descend to the scrotum**

At the birth should be located  
in the scrotum!

**1. First to the priliminary scrotum - pouch of the  
parietal peritoneum - proc. vaginalis peritonei**

## 2. Own descend



### Mechanism

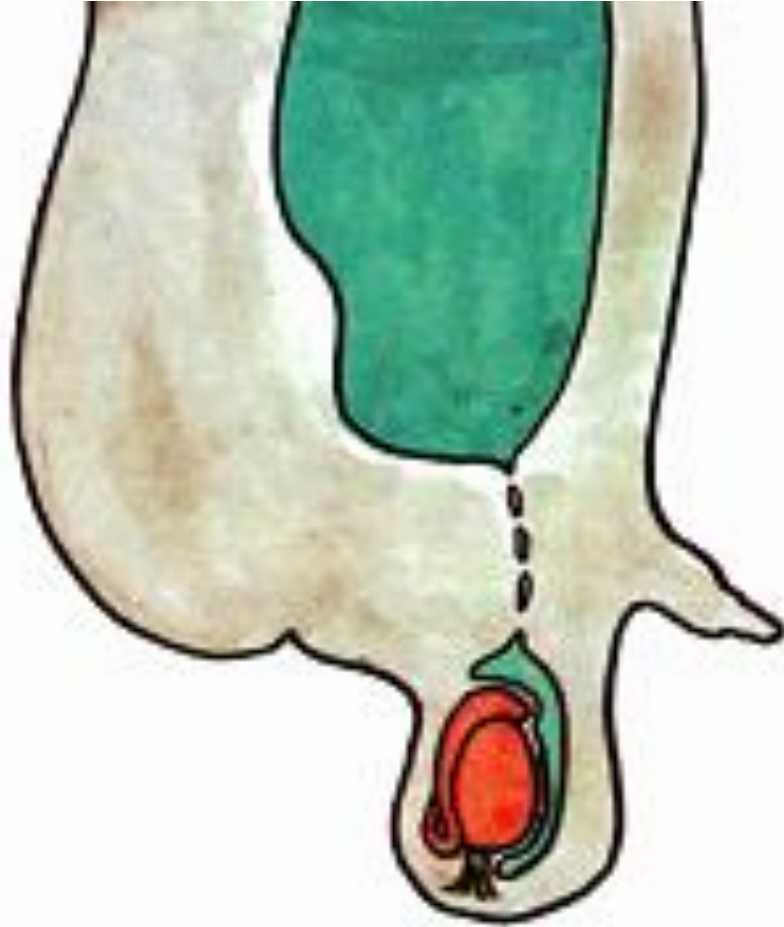
growing of the abdominal wall

Shortening of \*gubernaculum testis

Abdominal pressure + contraction of the muscles of the abdomen

It pass through the inguinal canal and takes all the layers with

**Testis + epididymis >to the pouch of the peritoneum > 2 laminas:**



**= lamina visceralis,  
epiorchium**

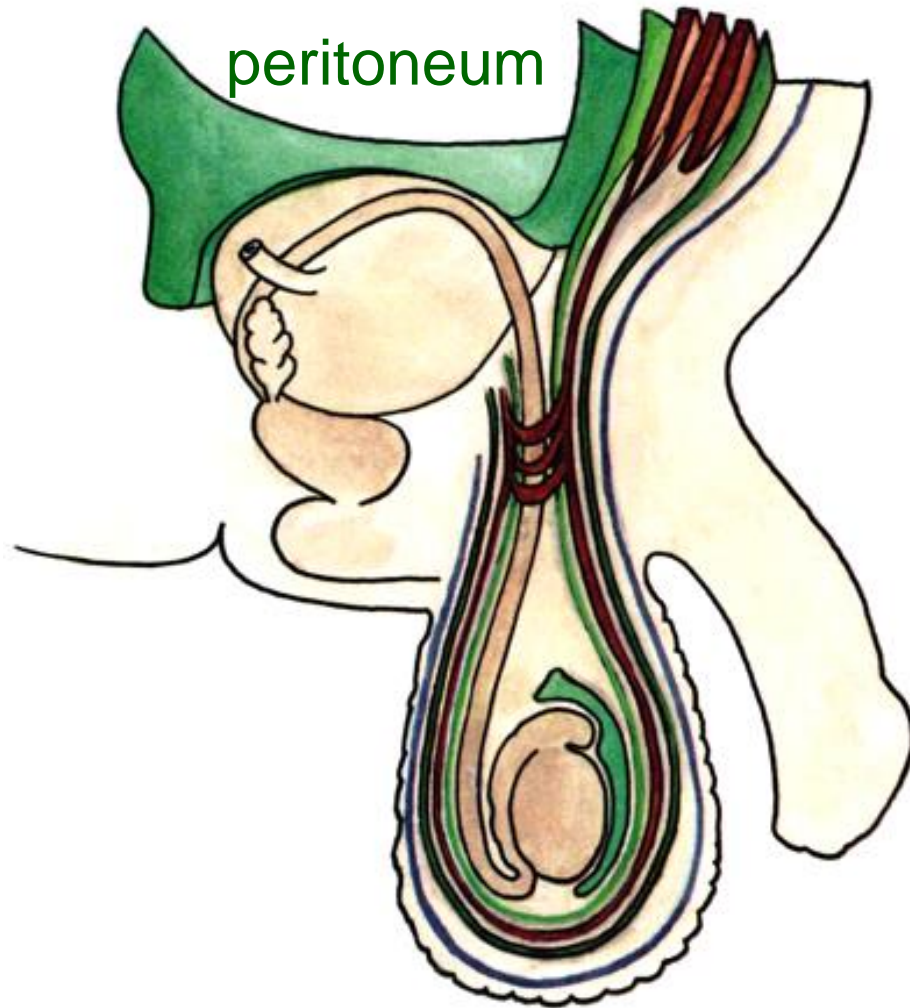
**Lamina that lines the  
scrotum = lamina parietalis,  
periorchium**

**Gubernaculum testis → Lig. scrotale**

**Processus vaginalis → Tunica vaginalis**

**Lig. vaginale**

# Coverings of the testes and epididymis



## Abdominal wall

**fascia transversalis**

**m. transv., obliqu. int., ~~ext.~~**

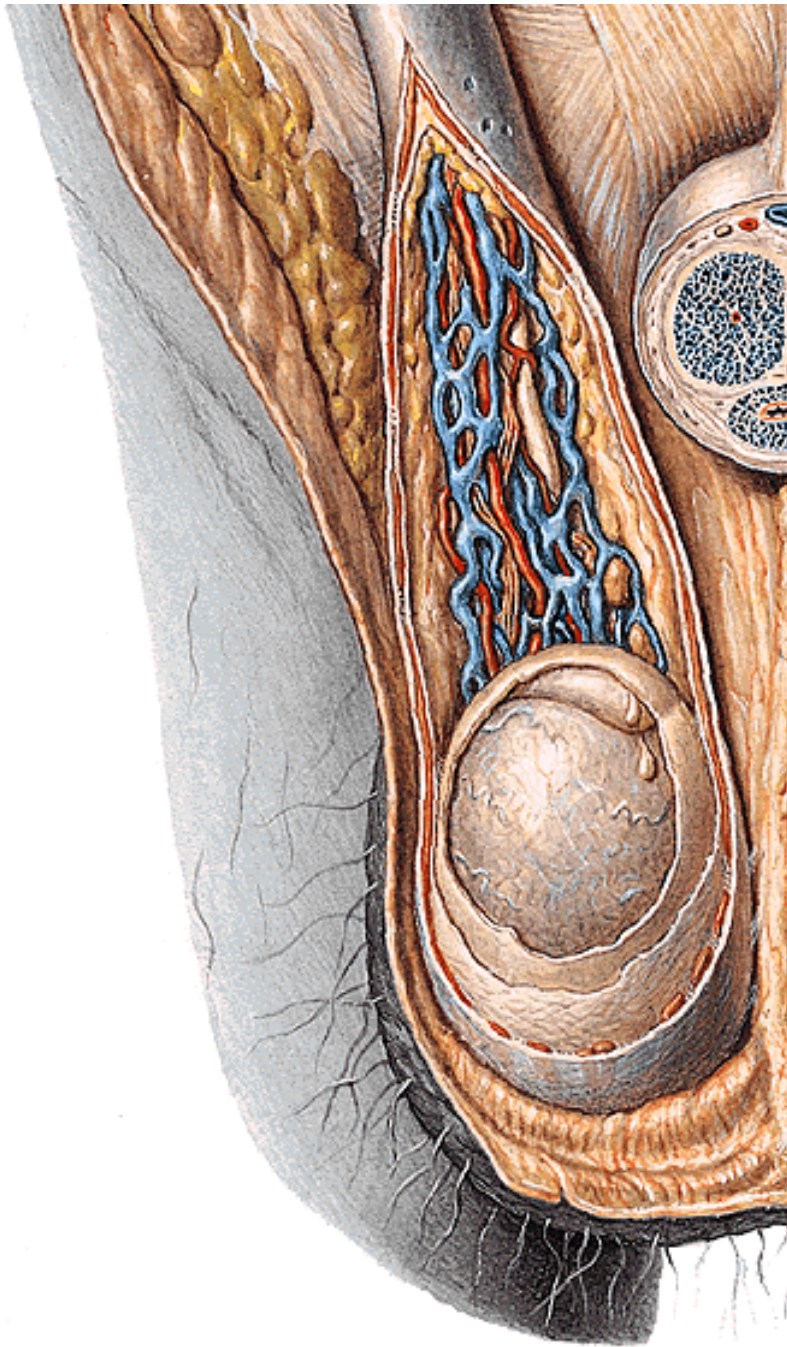
**fascia abdominis spf.**

## Coverings

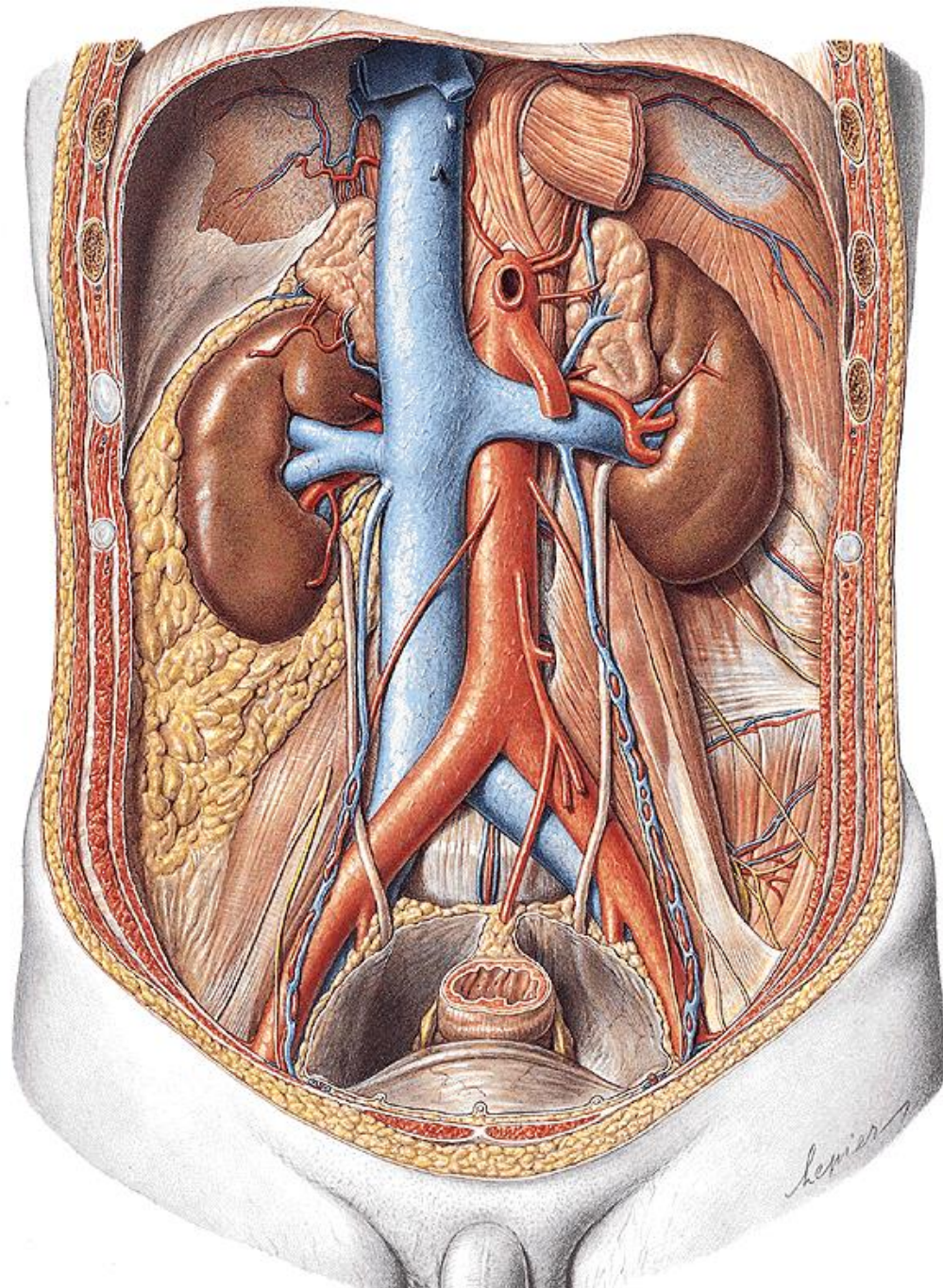
**fascia spermatica int.**

**m. cremaster**

**fascia spermatica ext.**



- ✓ epiorchium (l. visceralis)
- ✓ periorchium (l. parietalis)
- ✓ fascia spermaticas int.
- ✓ m. cremaster
- ✓ fascia spermatica ext.



The course of the descensus testium is shown by the course of **a.v. testicularis**

Retentio testis (cryptorchidism). Ectopia testis.

# Fossa supravesicalis

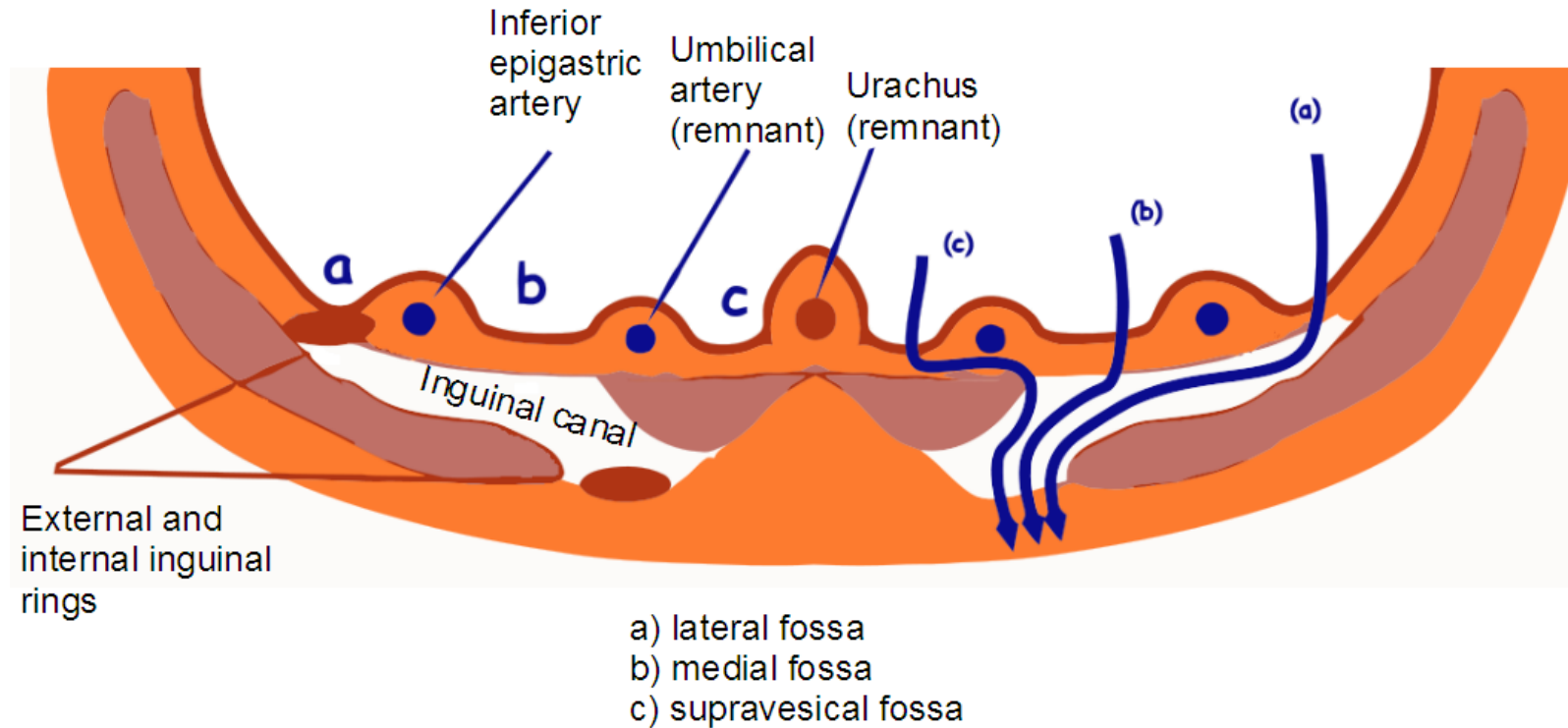
- hernia supravesicalis (c)

# Fossa inguinalis medialis

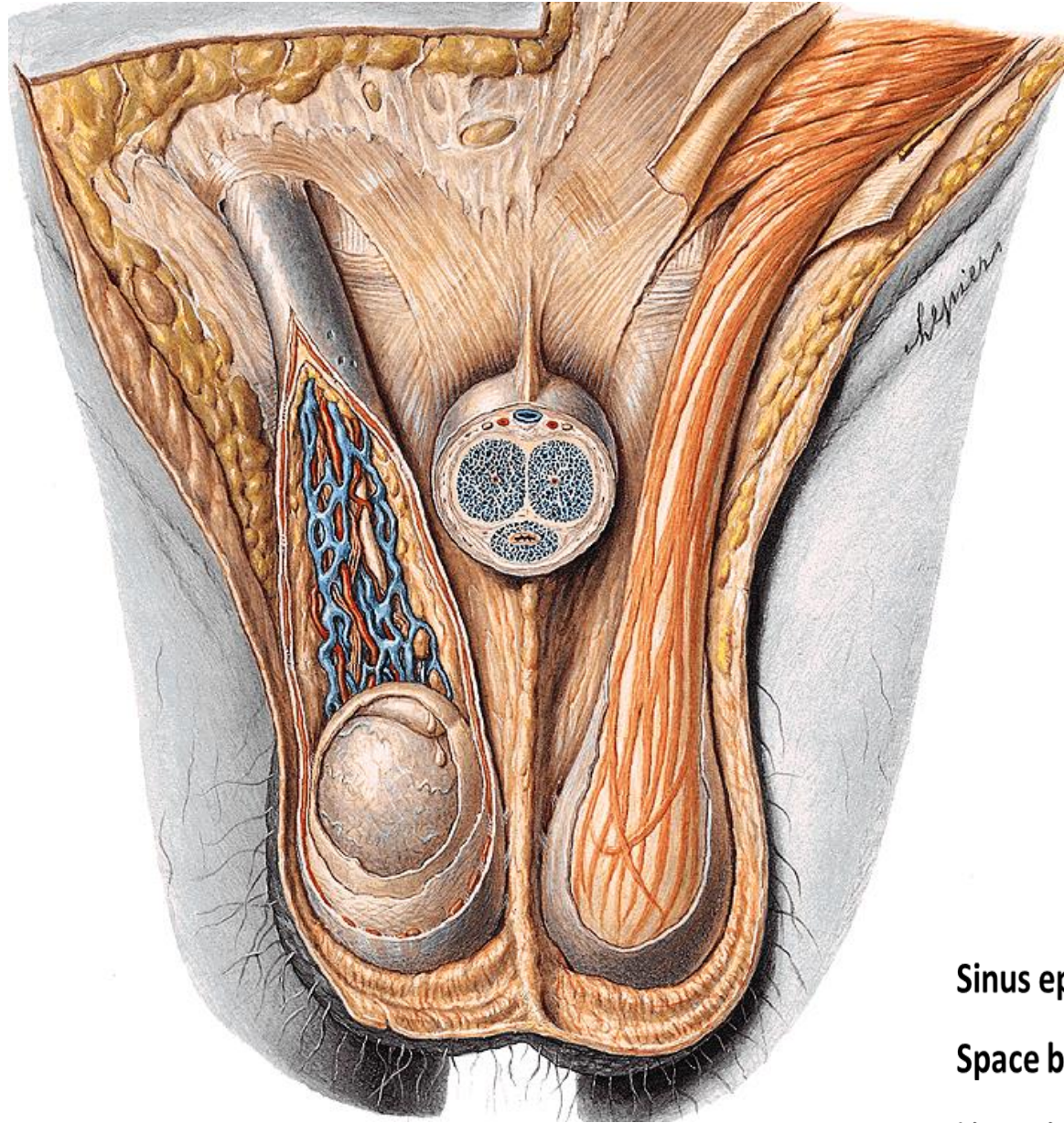
- hernia inguinalis directa (b)

# Fossa inguinalis lateralis

- hernia inguinalis indirecta (a)



# Testis



## Extremitas

**superior** (cr, ve)

**inferior** (ca, dors)

## Facies

**medialis**

**lateralis**

## Margo

**anterior**

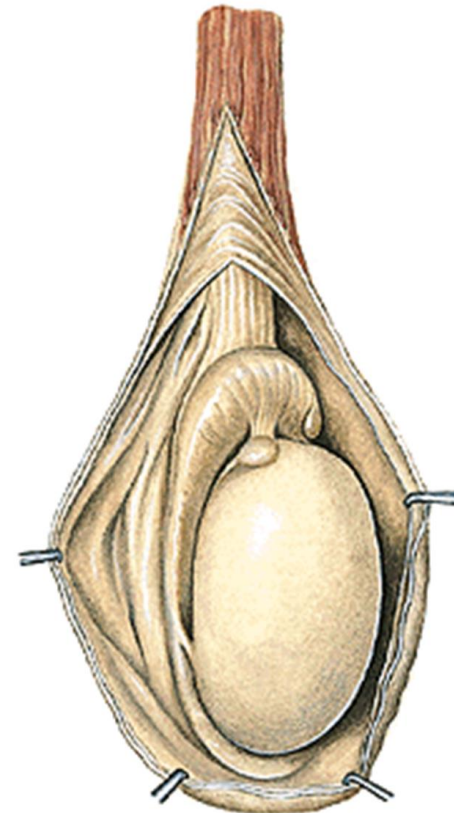
**posterior**

(hilus)

Sinus epididymidis

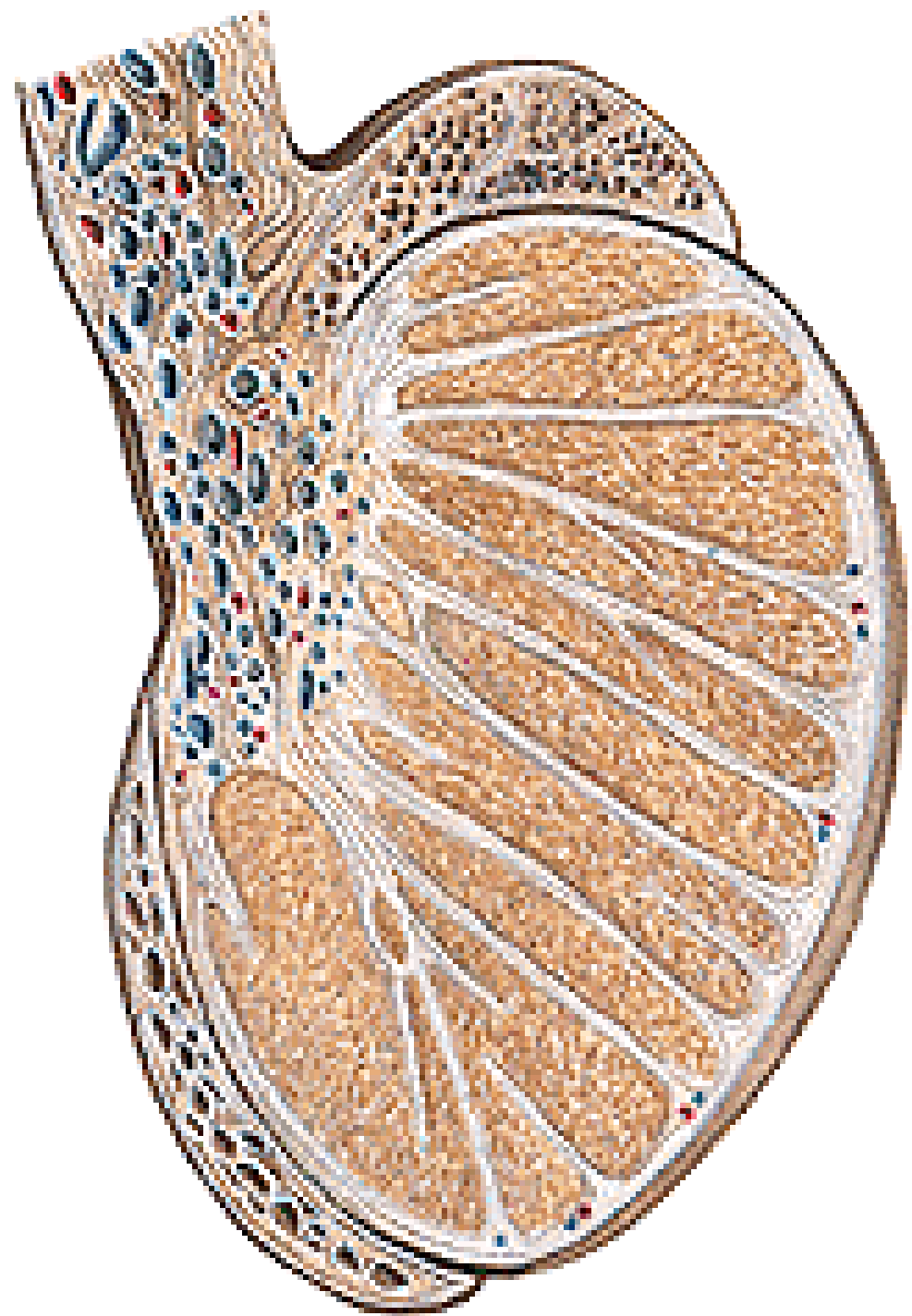
Space between lamina visceralis and testis and epididymis

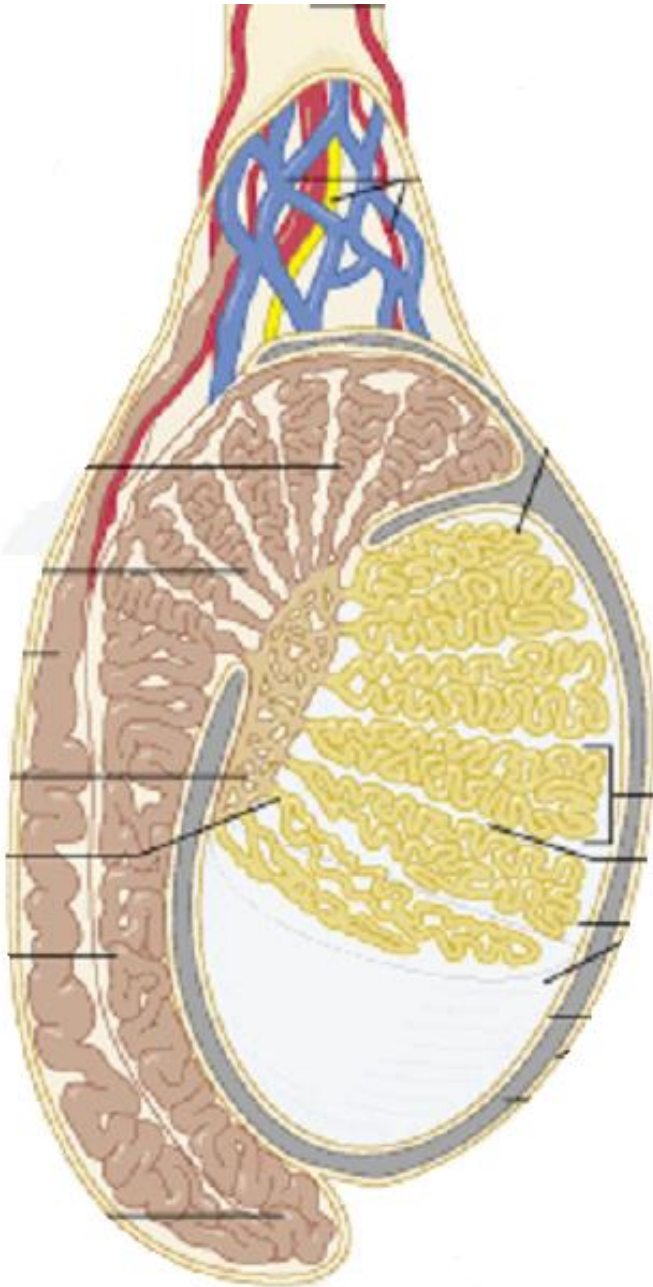
Lig. epididymis sup. et inf.



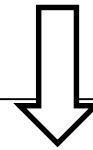


**Tunica albuginea**  
**Mediastinum testis (post)**  
**Septula testis**  
**Lobuli testis (200-300)**  
**Hilum testis**





In lobuli testis :  
**tubuli seminiferi contorti**  
→ **tubulus seminif. rectus**  
→ **rete testis**  
→ **ductuli eff. testis (10-14)**  
→ **tubuli epididymidis**



**dct. epididymidis**  
→ **dct. deferens**

**Spermatozoa**  
**Interstitial cells of Leydig**

# EPIDIDYMIS

Caput epididymidis

Corpus epididymidis

Cauda epididymidis

Sinus epididymidis

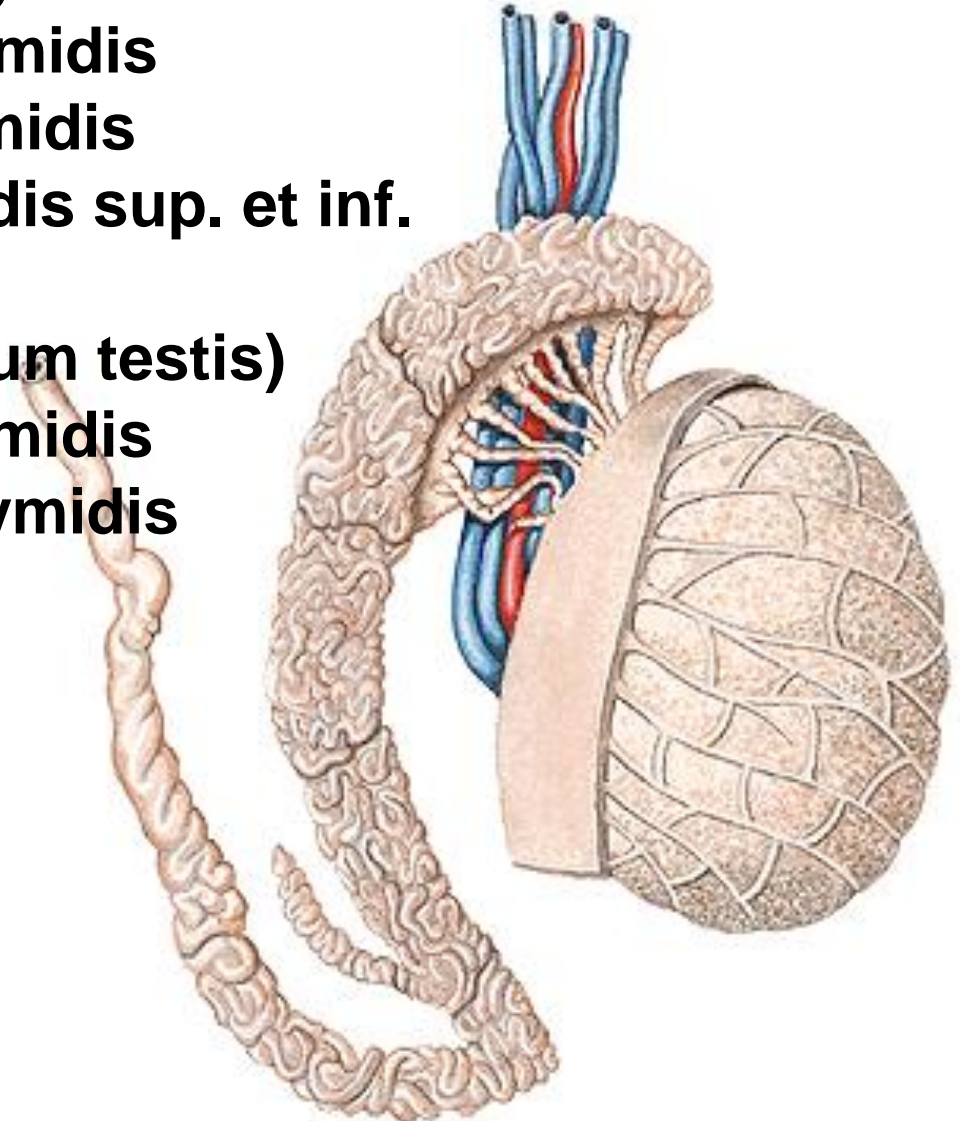
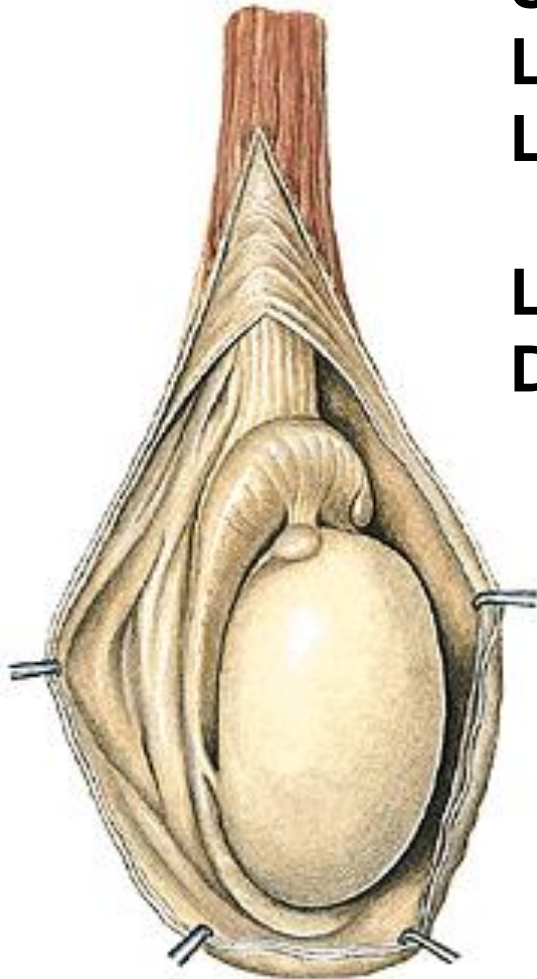
Lig. epididymidis sup. et inf.

Lig. scrotale

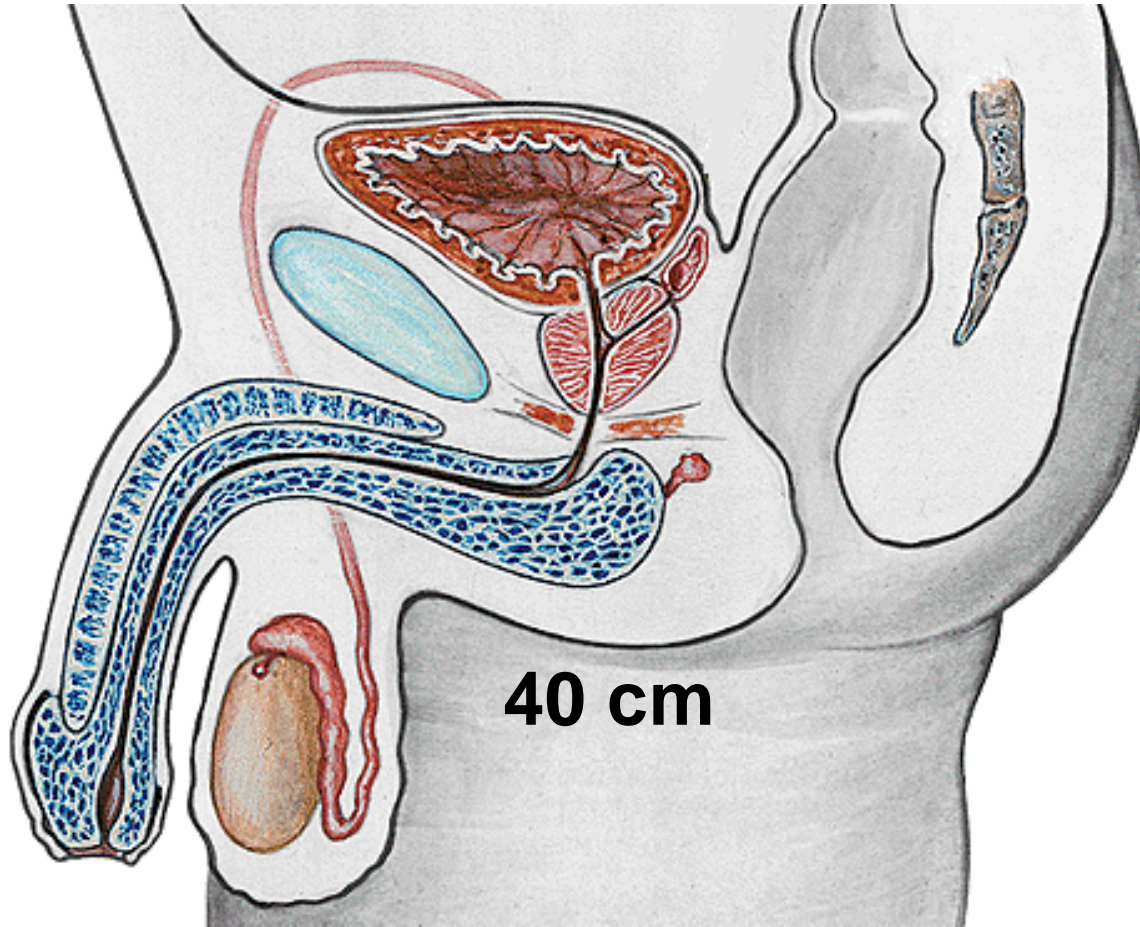
(Gubernaculum testis)

Lobuli epididymidis

Ductus epididymidis



# Ductus deferens



## course

Scrotum

funiculus spermaticus

canalis inguinalis

Small pelvis

# DUCTUS DEFERENS (VAS DEFERENS)

Pars epididymica

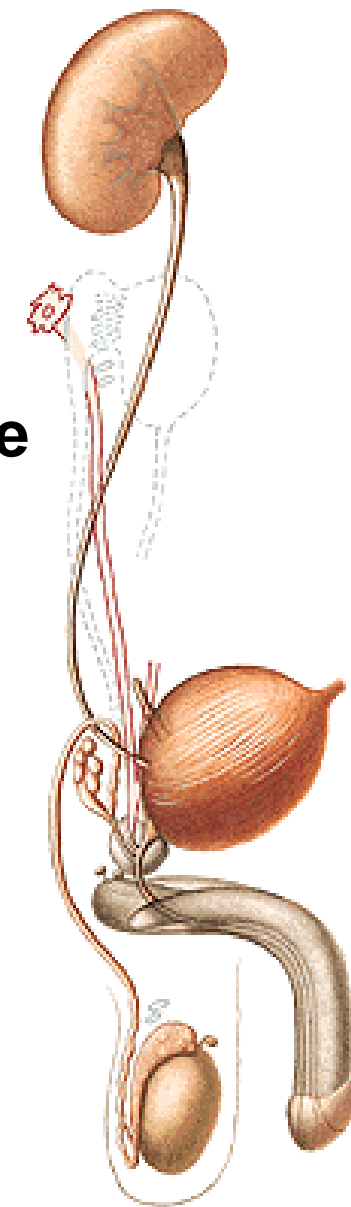
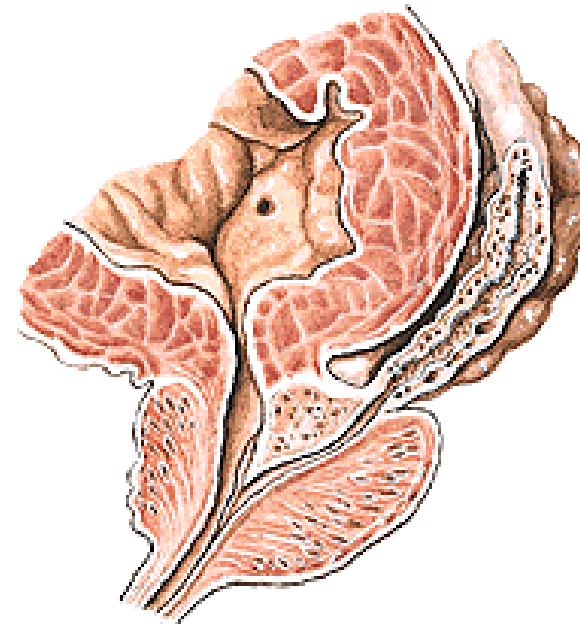
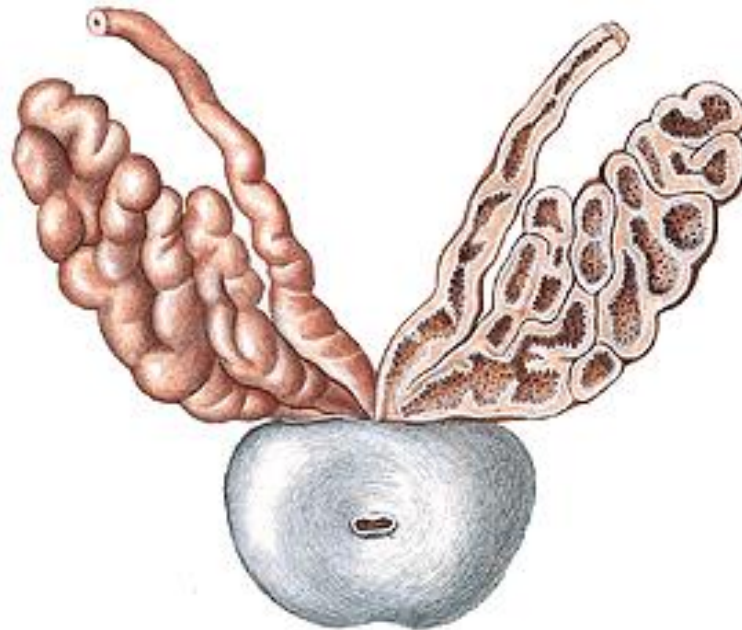
Pars funicularis

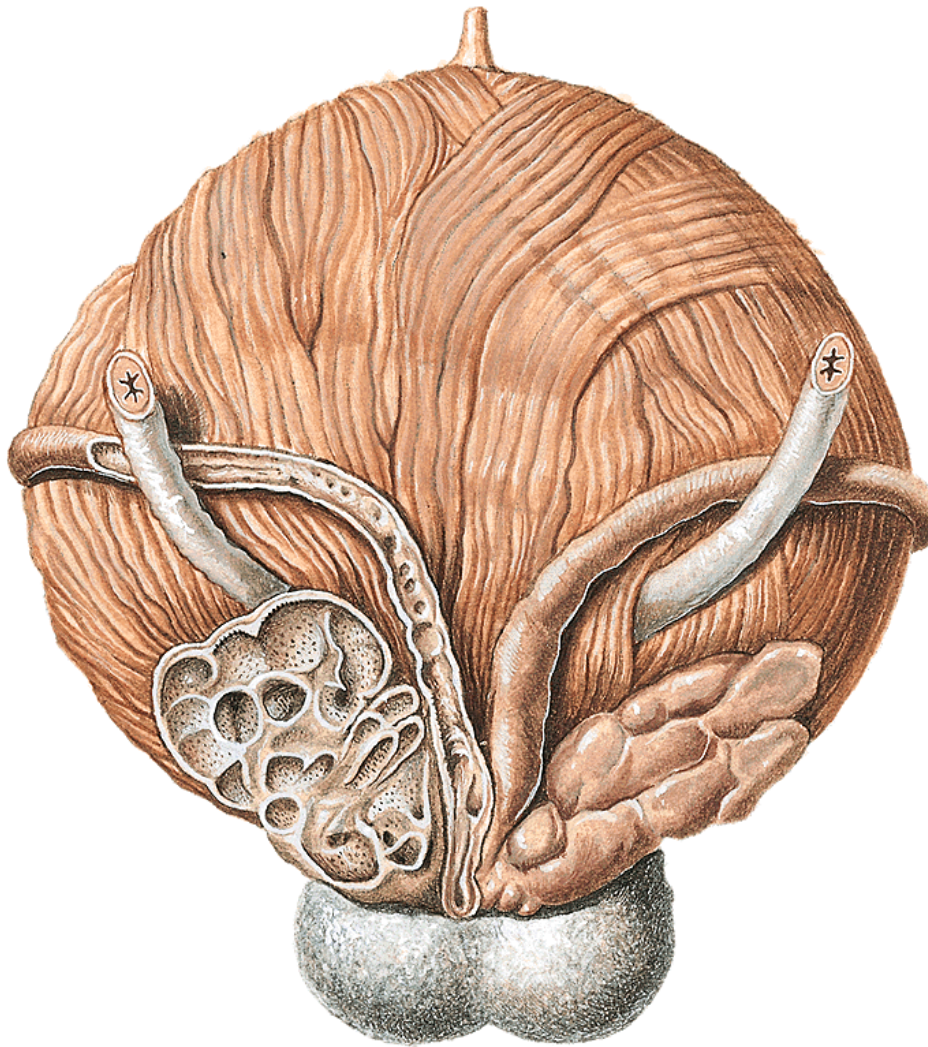
Pars inguinalis

Pars pelvina

Ampulla ductus deferentis - diverticula ampullae

Ductus ejaculatorius – colliculus seminalis





- Crosses the ureter
- Enlarges - **ampulla**
- Ductus deferens + ductus excretorius from the seminal vesicles > **ductus ejaculatorius**
- Passes through the prostate
- Opens in urethra



mucosa  
muscle  
Adventitia

# FUNICULUS SPERMATICUS: A. testicularis

spermatic cord

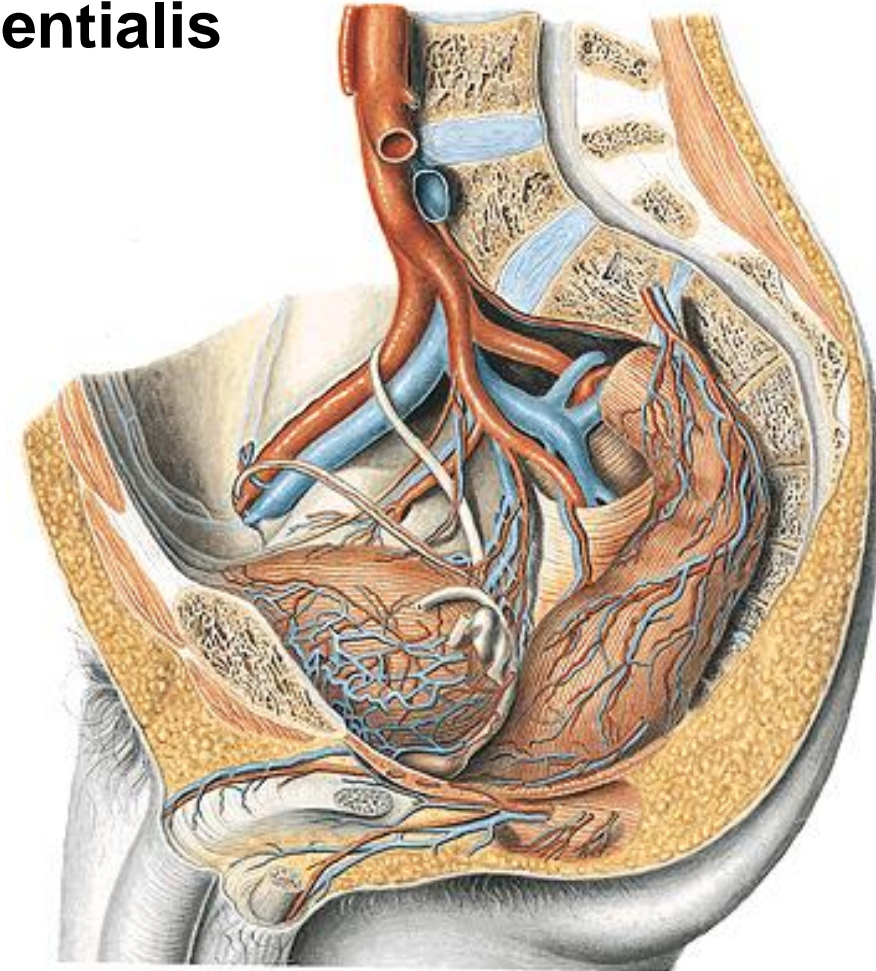
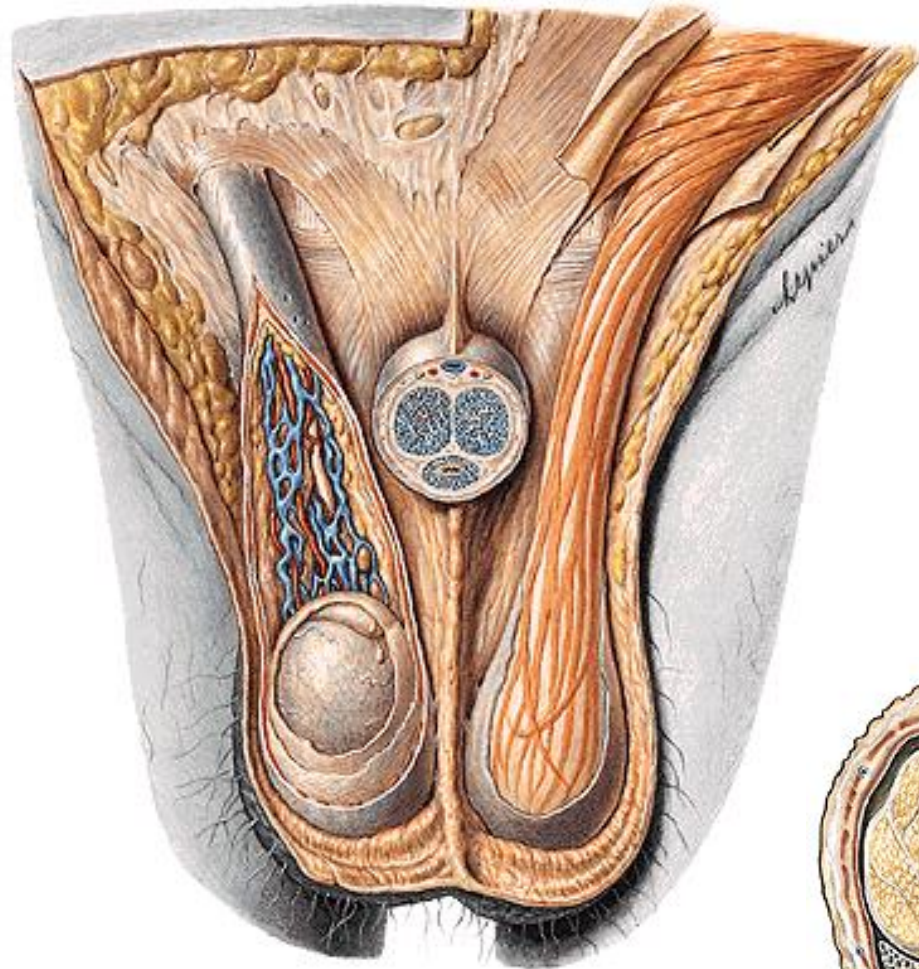
Plexus testicularis

Plexus pampiniformis

Ductus deferens

A. ductus deferentis

Plexus deferentialis



**COVERINGS**

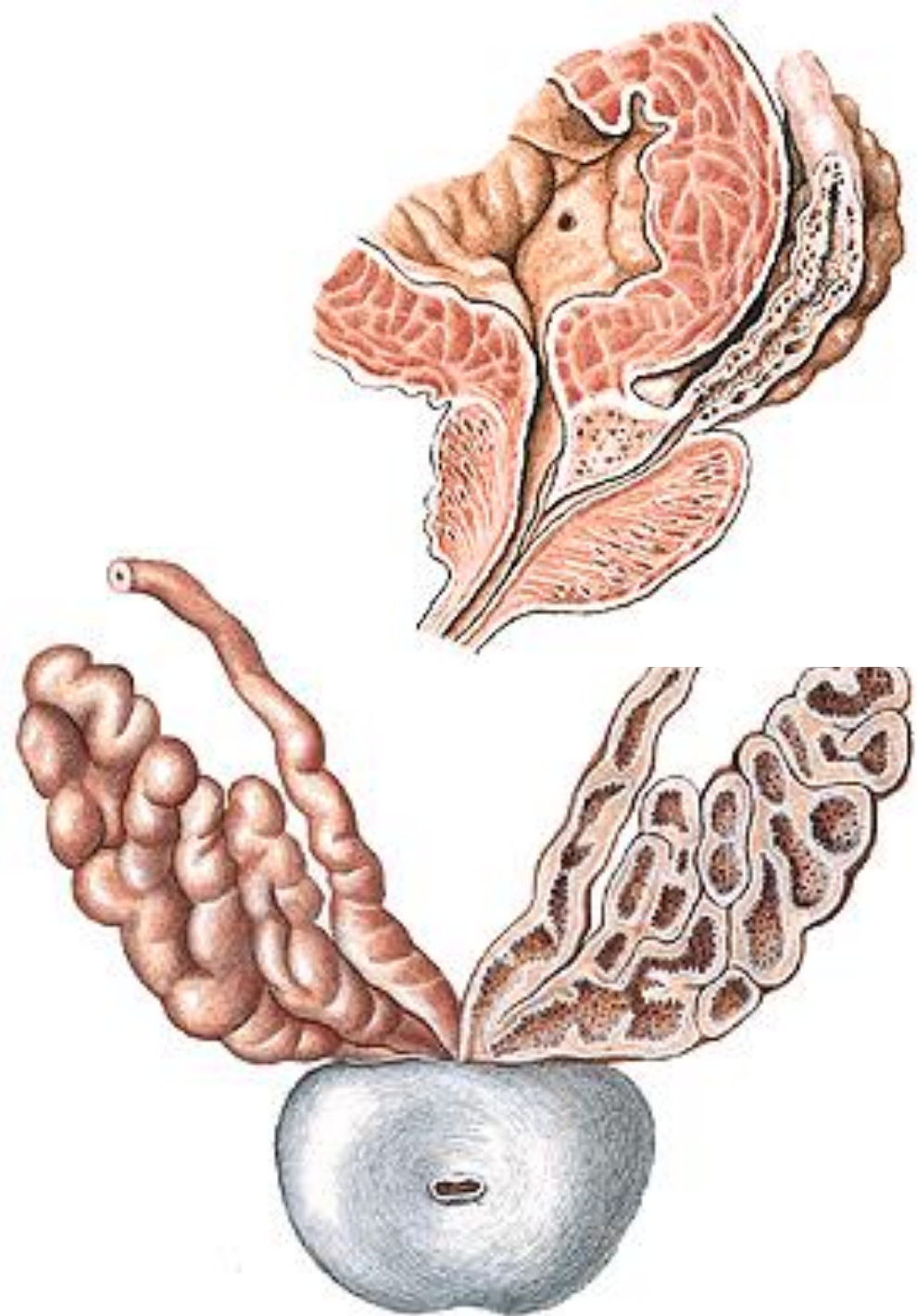
# VESICULA SEMINALIS

Ductus excretorius

Ductus ejaculatorius

Localisation

Alcalic secretion

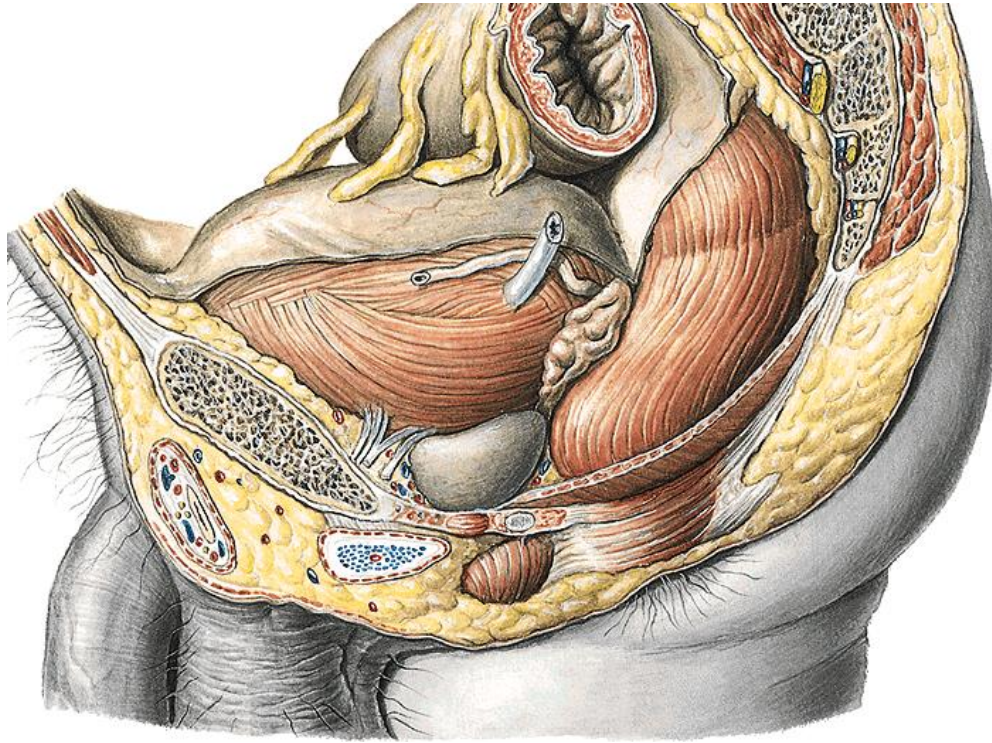




## Seminal vesiculography



# Prostata



**Basis**

**Apex**

**Facies anterior (symphysis)**

**Facies posterior (rectum)**

**Facies inferolaterales (pelvic floor)**

**Lobus medius**

**Lobus dexter et sinister**

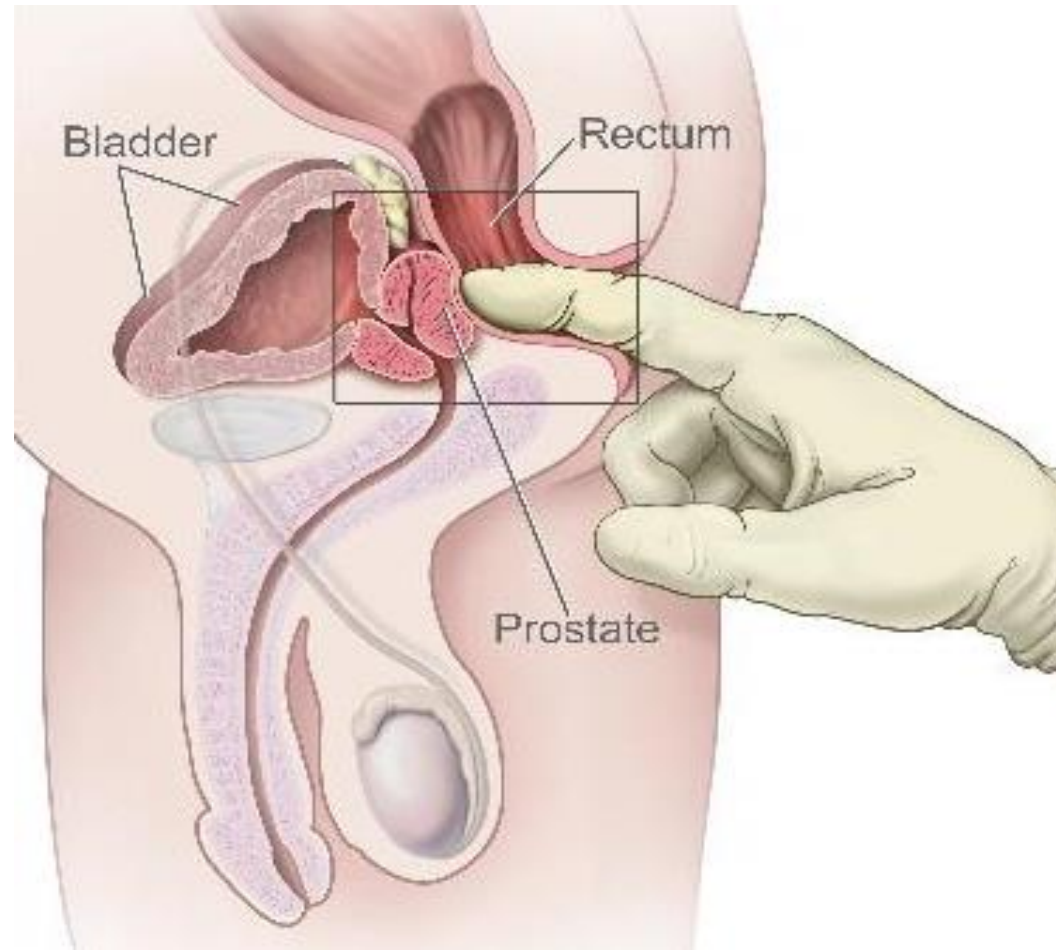
**Isthmus**

On the surface capsula propria

Around venous plexus prostaticus

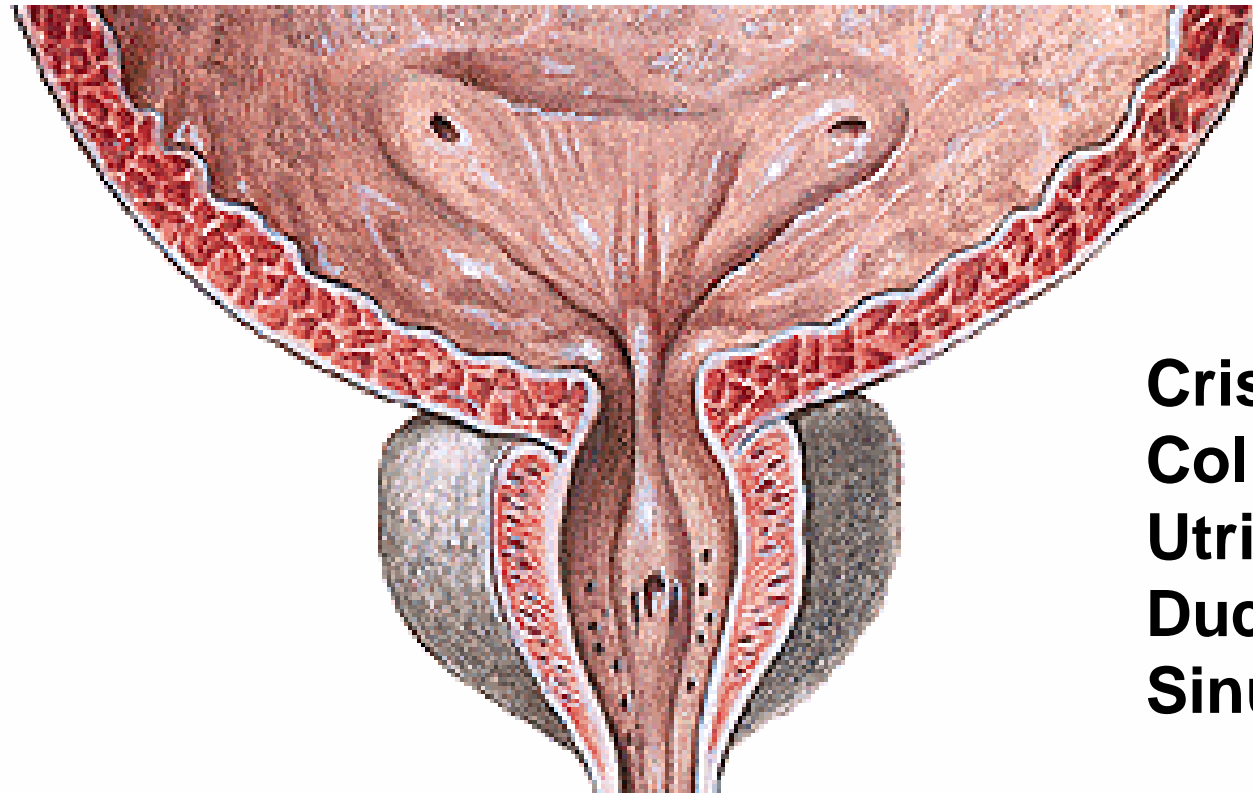
capsula periprostatica (visc. Lamina of pelvic fascie)

# Clinical window



Examination of seminal vesicles and prostate  
„per rectum“

**30-50 tuboalv. gl. prostaticae + stroma from  
connective tissue (lig.) + smooth muscle**



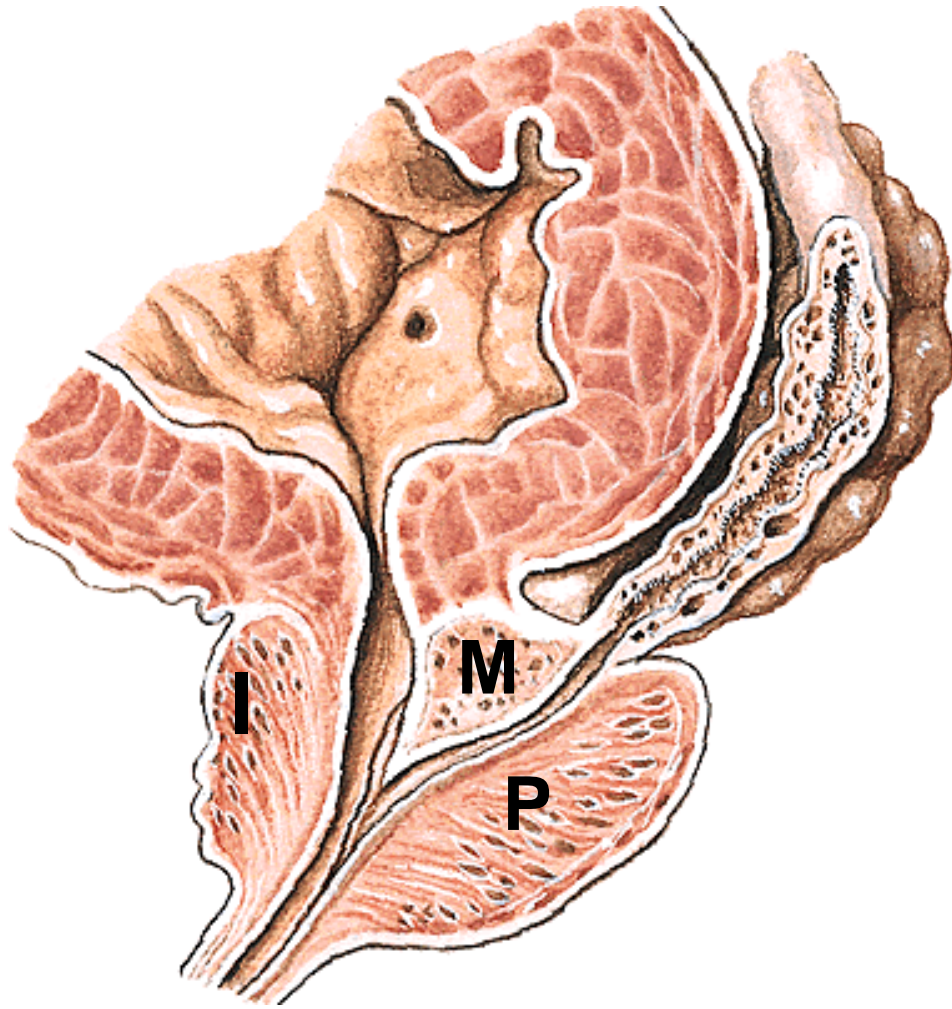
**Basis**



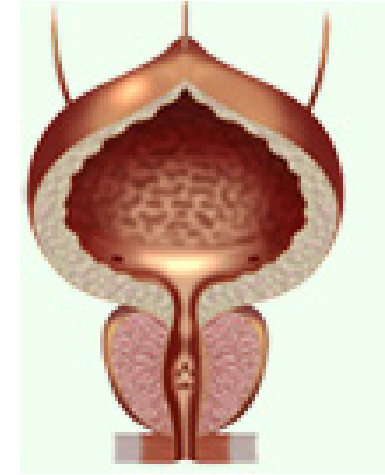
**Apex**

**Crista urethralis  
Colliculus seminalis  
Utriculus prostaticus  
Ductus ejaculatorii  
Sinus prostatici**

Urethra pass though the prostate



**Lobus dx.**  
**Lobus sin.**



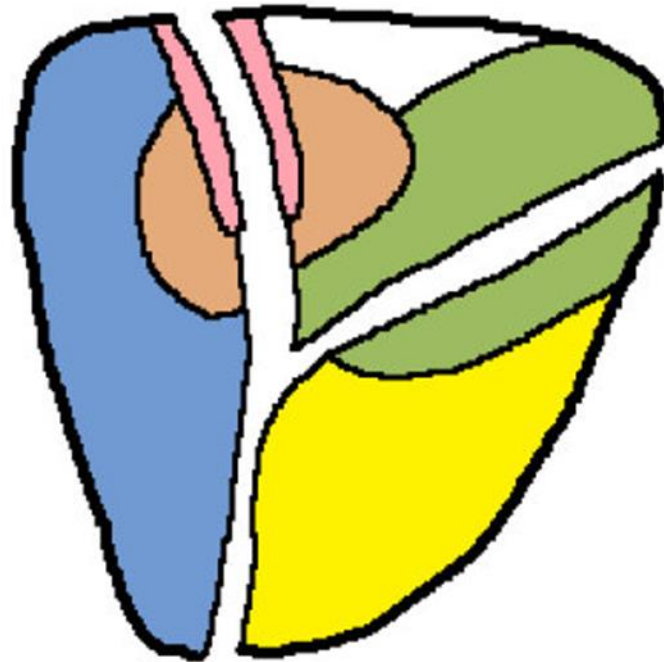
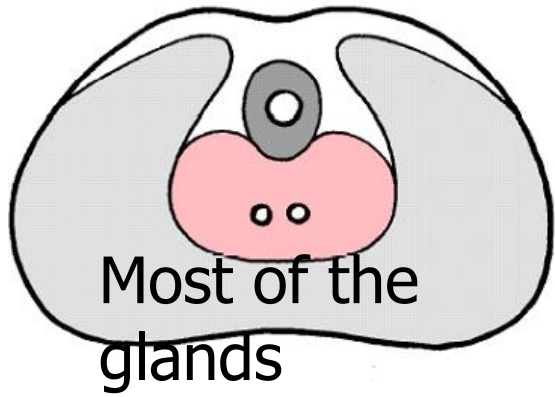
**Isthmus prostatae**

**Lobus post.**

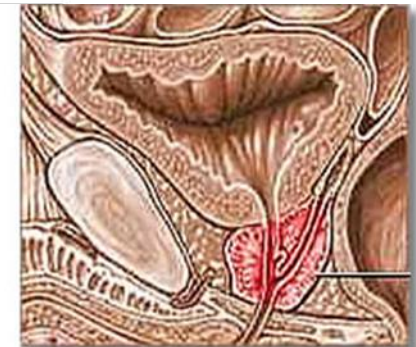
**Lobus medius**

(urethra  $\longleftrightarrow$  dct.ejaculat.)

# Prostatic zones



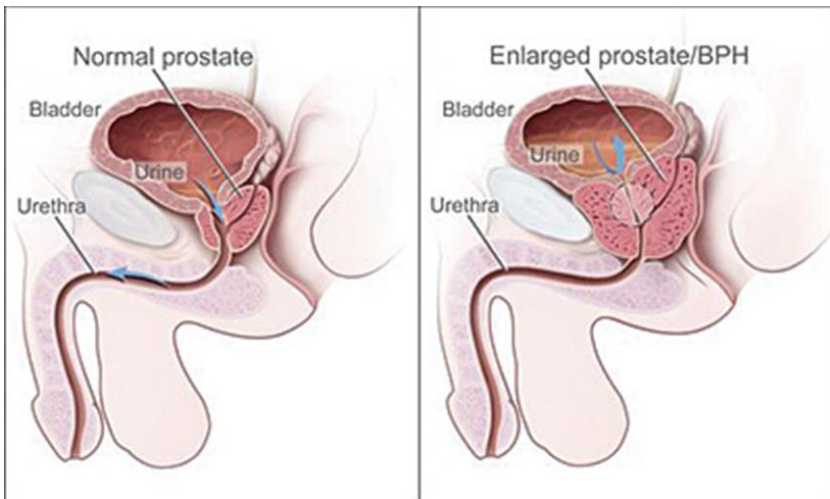
- Anterior Fibromuscular Zone
- Preprostatic Sphincter
- Transitional Zone
- Central Zone
- Peripheral Zone



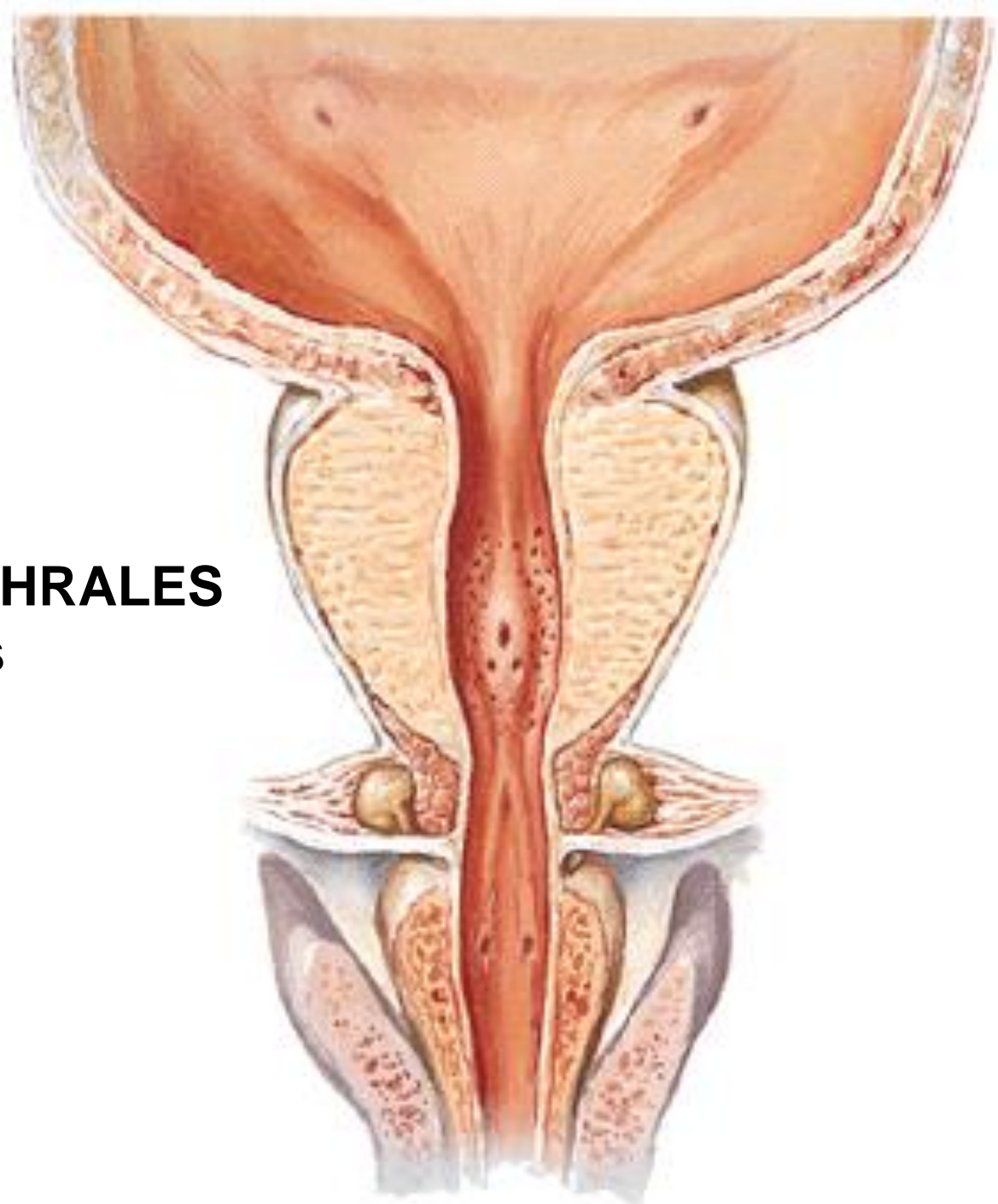
Normal Prostate



Prostate Cancer



**GLANDULAE BULBOURETHRALES**  
**Ductus gl. bulbourethralis**



# Penis



## Radix

## Corpus

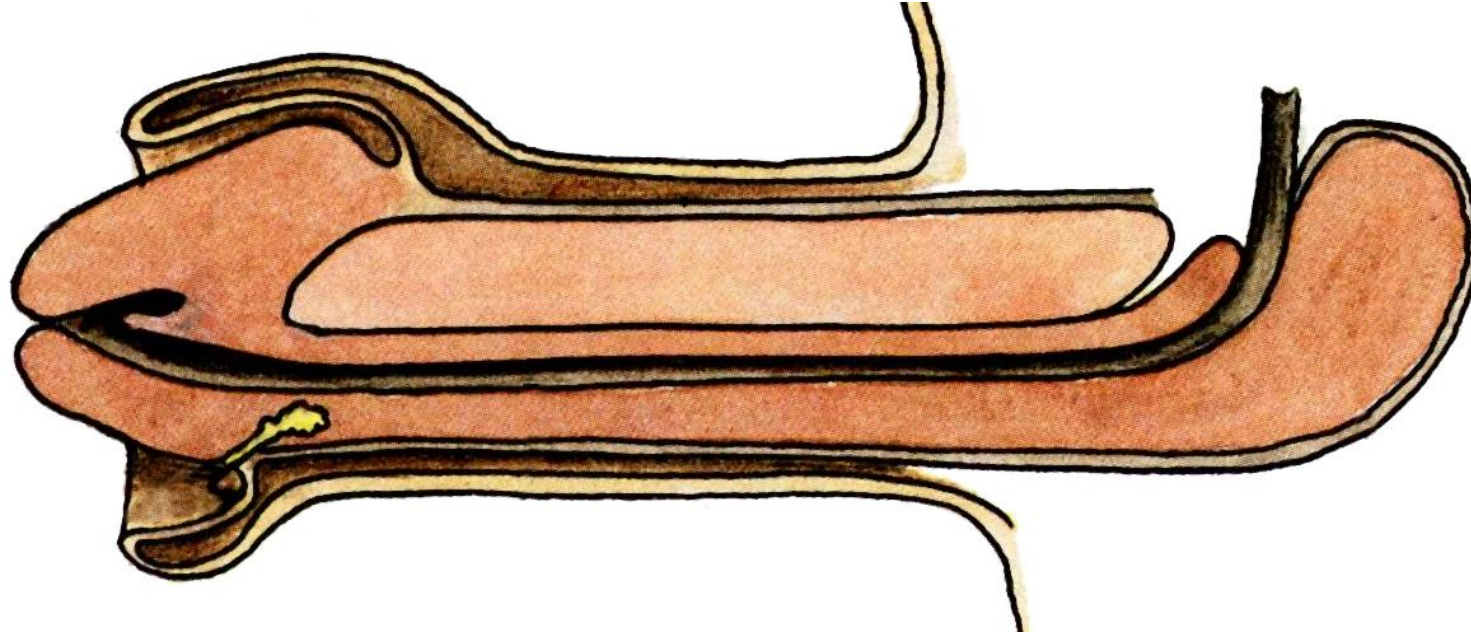
facies dorsalis  
facies urethralis  
(raphe penis)

## Glans

collum glandis  
corona glandis  
ostium urethrae ext.



**Praeputium:** ostium praeputii  
gll. praeputiales (smegma praeputii)



**Fossa navicularis urethrae**  
(valvula, recessus)



## **COVERINGS OF PENIS:**

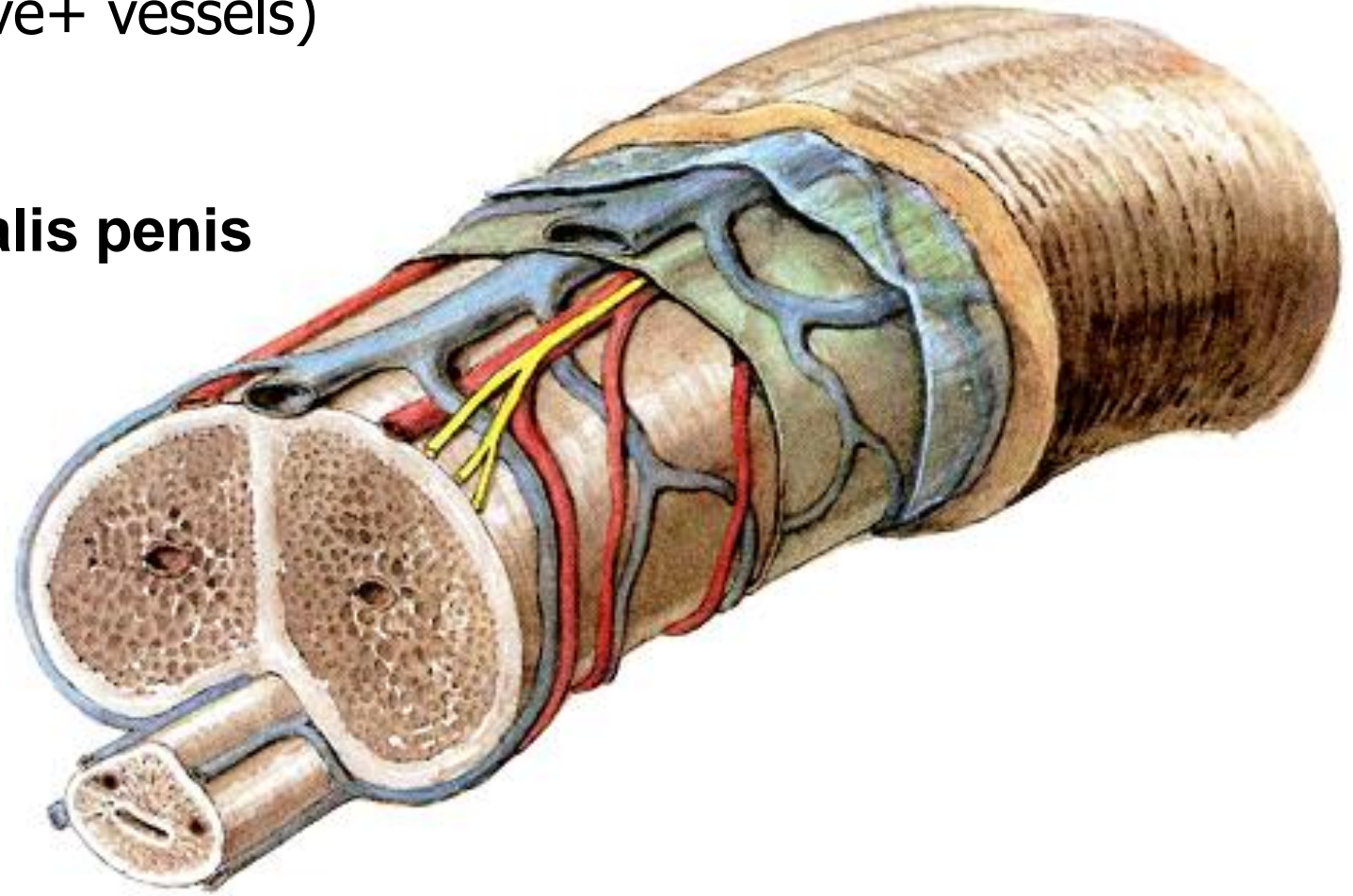
**Skin** (+ smooth muscle= tunica dartos)

**Fascia penis superficialis** (+ nerve+ vessels)

(Vv. dorsales penis spf.)

**Fascia penis profunda**

(Aa., Nn. dorsales penis, V. dorsalis penis profunda)



**Cavernous bodies**(+ urethra)

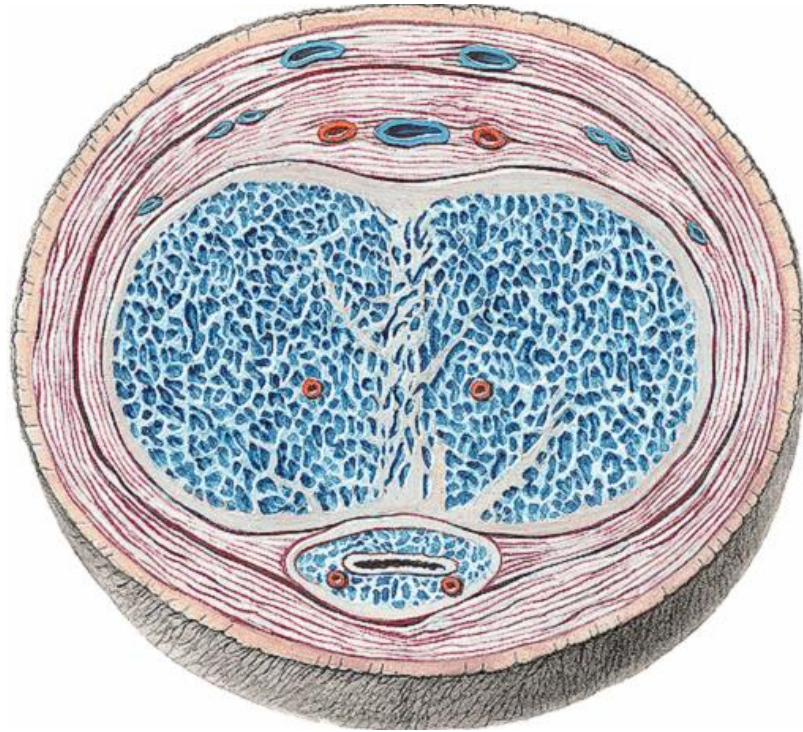


# **Cavernous bodies**

**Corpora cavernosa penis  
crura  
corpus**

**Corpus spongiosum penis  
bulbus  
corpus  
glans**

# Structure of the cavernous bodies



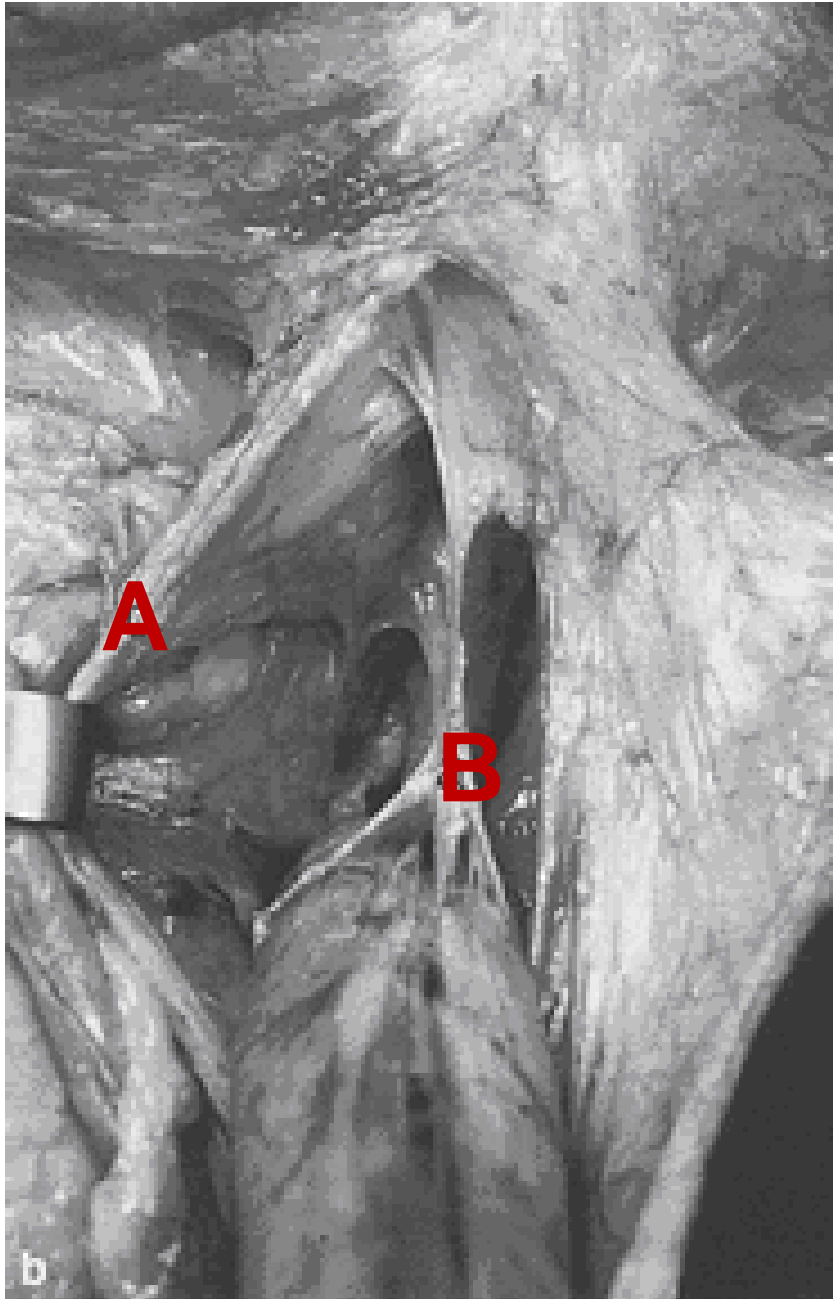
**Tunica albuginea** (no on the glans)

→ **trabeculae**

**Cavernae**

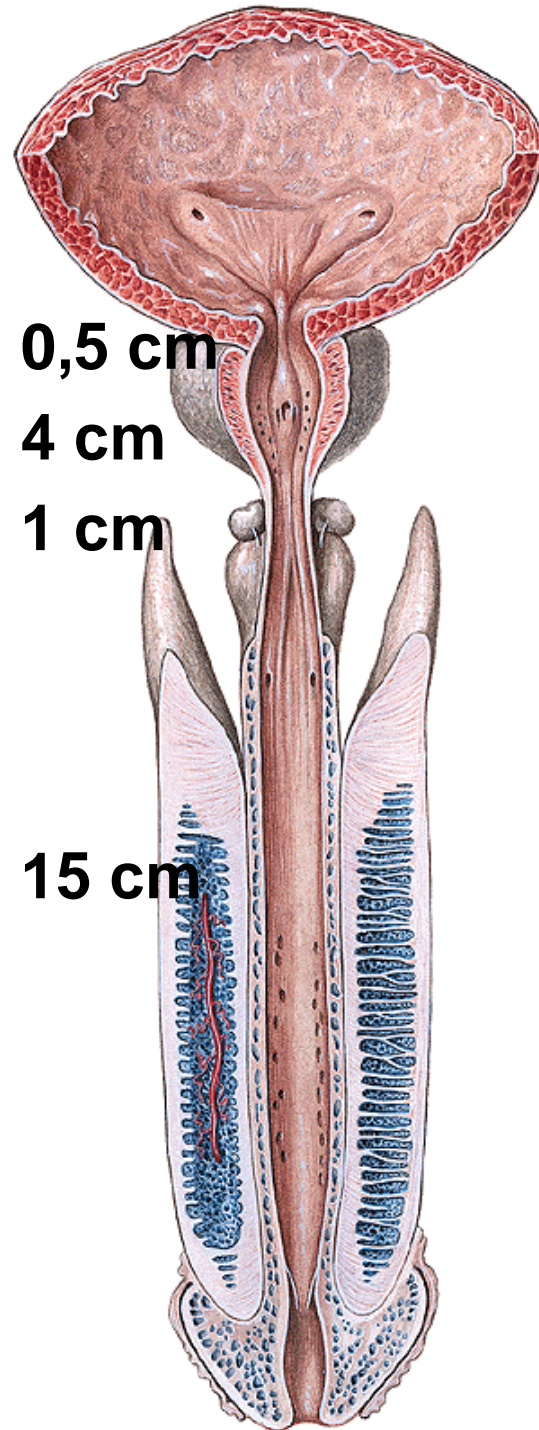
To them: **aa. helicinae**

away: **vv. cavernosae**



## Fixation of the penis

- A Lig. fundiforme penis**  
= fascia abdominalis  
from linea alba  
loops penis, push it up
- B Lig. susp. penis**  
From symphysis  
hold penis to symphysis



# Urethra masculina

20-25 cm

Ostium urethrae int. et ext.

## Posterior urethra

p. intramuralis M. sphincter vesicae smooth

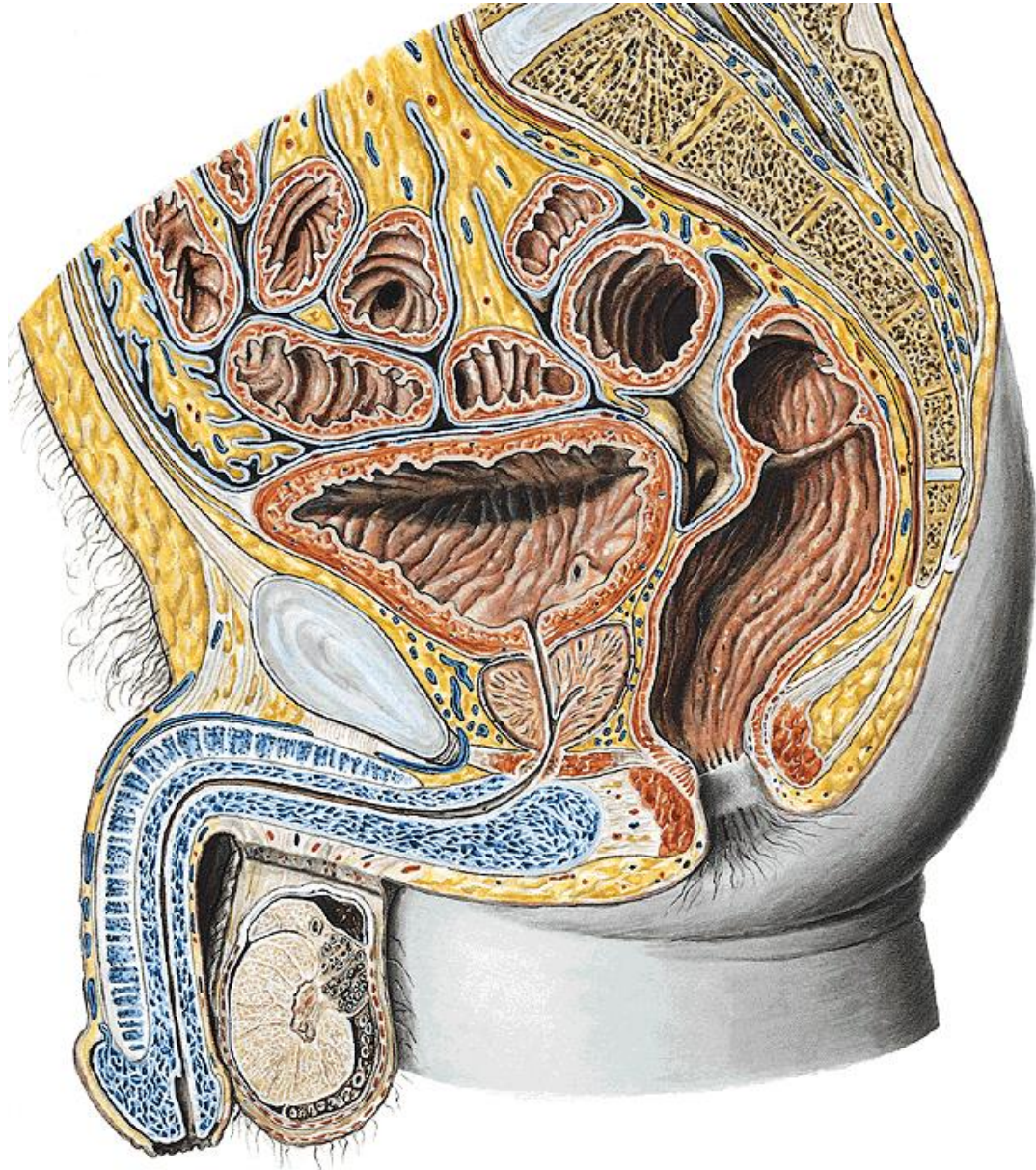
p. prostatica

p. diaphragmatica M. sphincter urethrae  
(striated)

## Anterior urethra

p. spongiosa – ampulla urethrae

# Curvatures of the urethra



**Curvatura subpubica  
= urethra fixa**

**Curvatura praepubica  
= urethra mobile**

**Cystoscopy!!!**

# Scrotum



**skin** (tunica dartos, raphe, pubes)

**Septum**

**Function** – temperature regulation of the testes

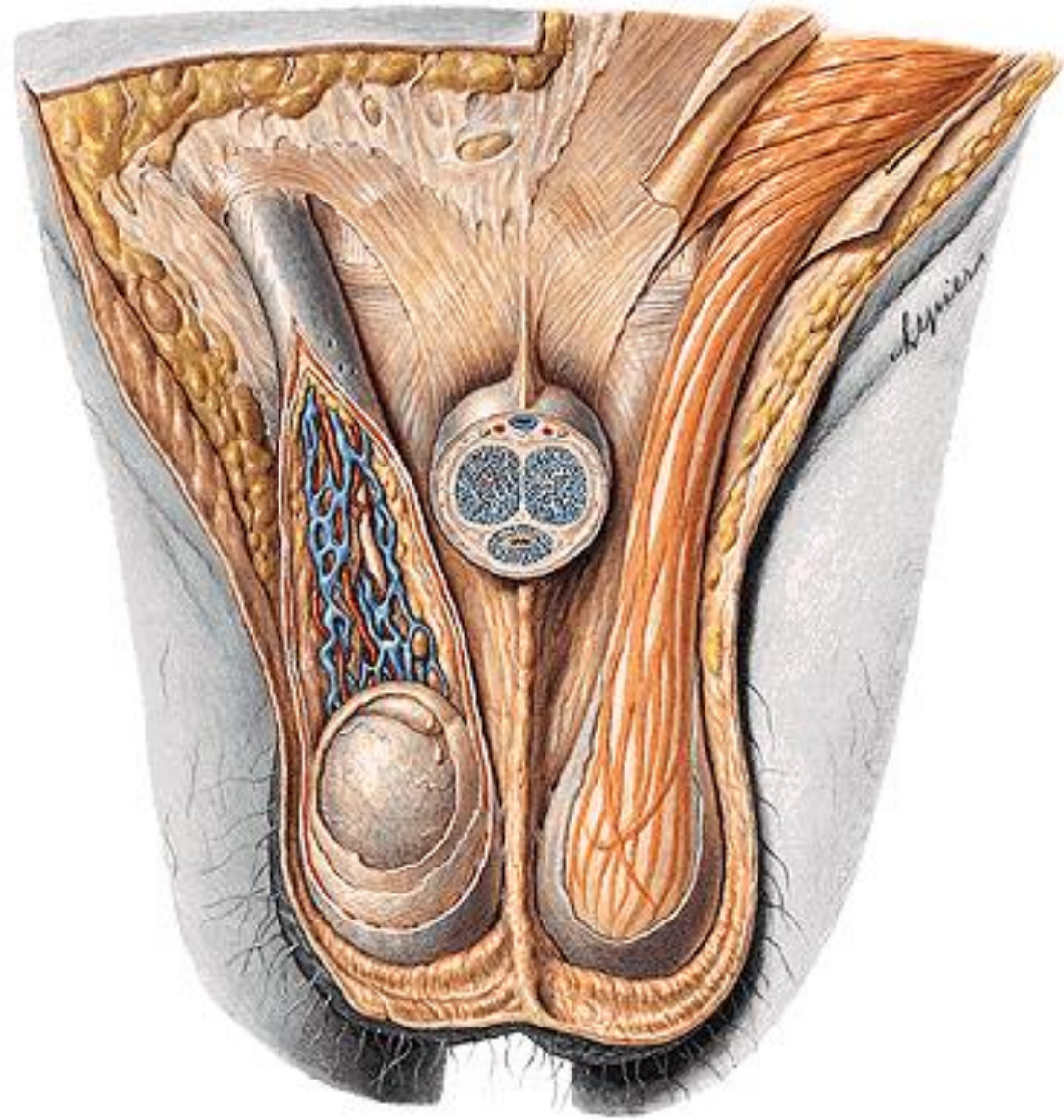


# SCROTUM

Tunica dartos scroti

Septum scroti

Cavitas scroti



Illustrations were copied from:

**Atlas der Anatomie des Menschen/Sobotta.  
Putz,R., und Pabst,R. 20. Auflage. München:  
Urban & Schwarzenberg, 1993)**

**Netter: Interactive Atlas of Human Anatomy.  
Windows Version 2.0**

**Čihák R: Anatomie 2 (Splanchnologia). Avicenum,  
zdravotnické nakladatelství, Praha, 1988.**