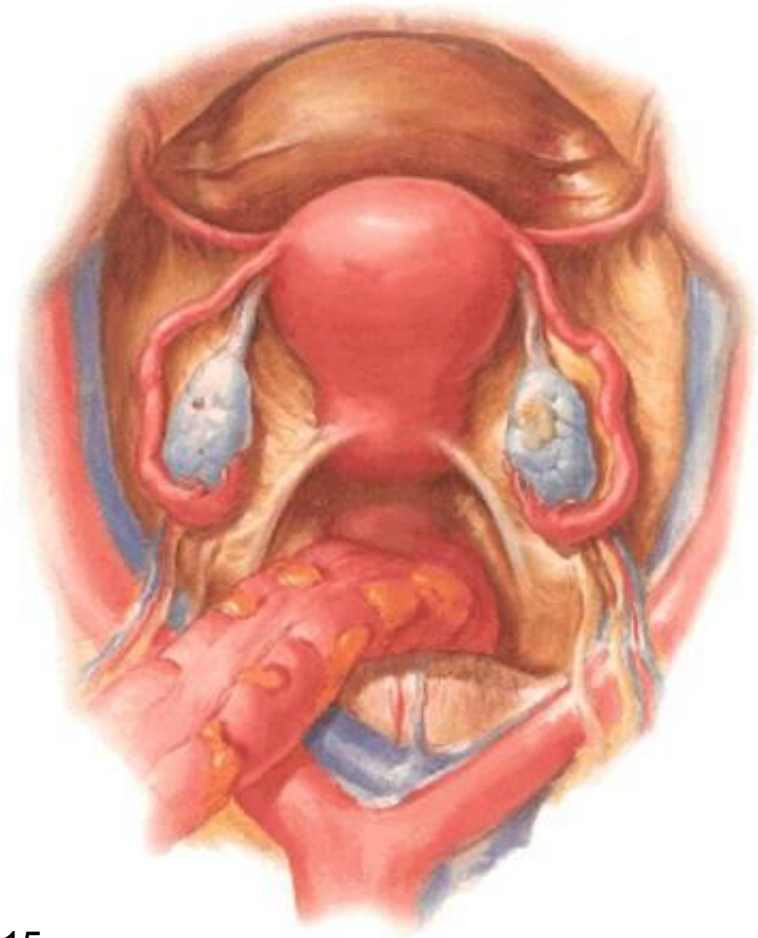


# Female internal genital organs

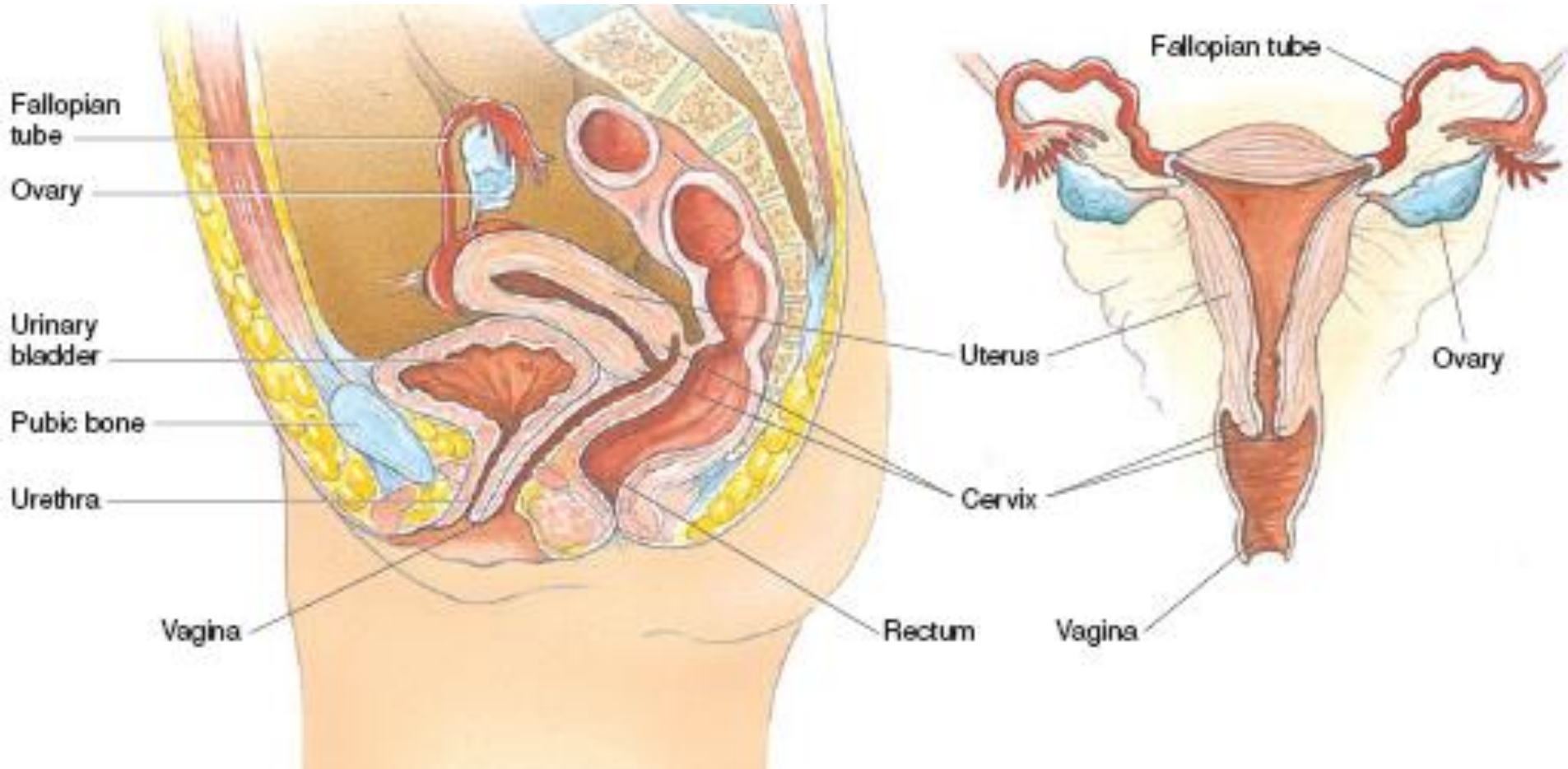
## *Organa genitalia feminina interna*

- ovarium
- tuba uterina / salpinx =  
uterine tube
- uterus
- vagina
- embryonal remnants  
(epoophoron, paroophoron)

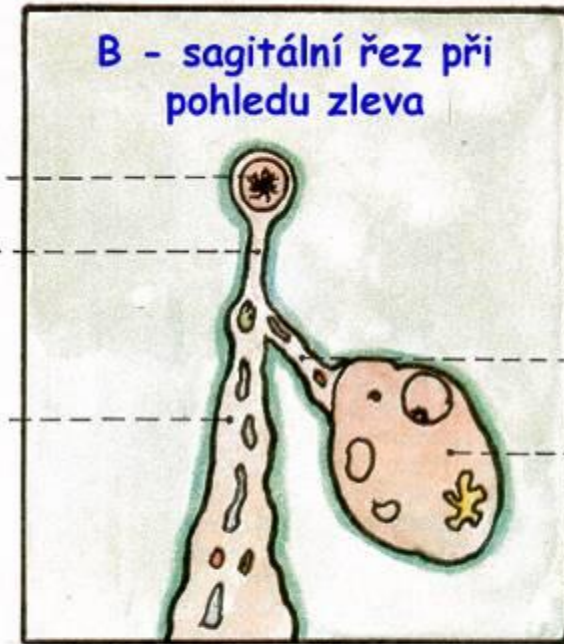
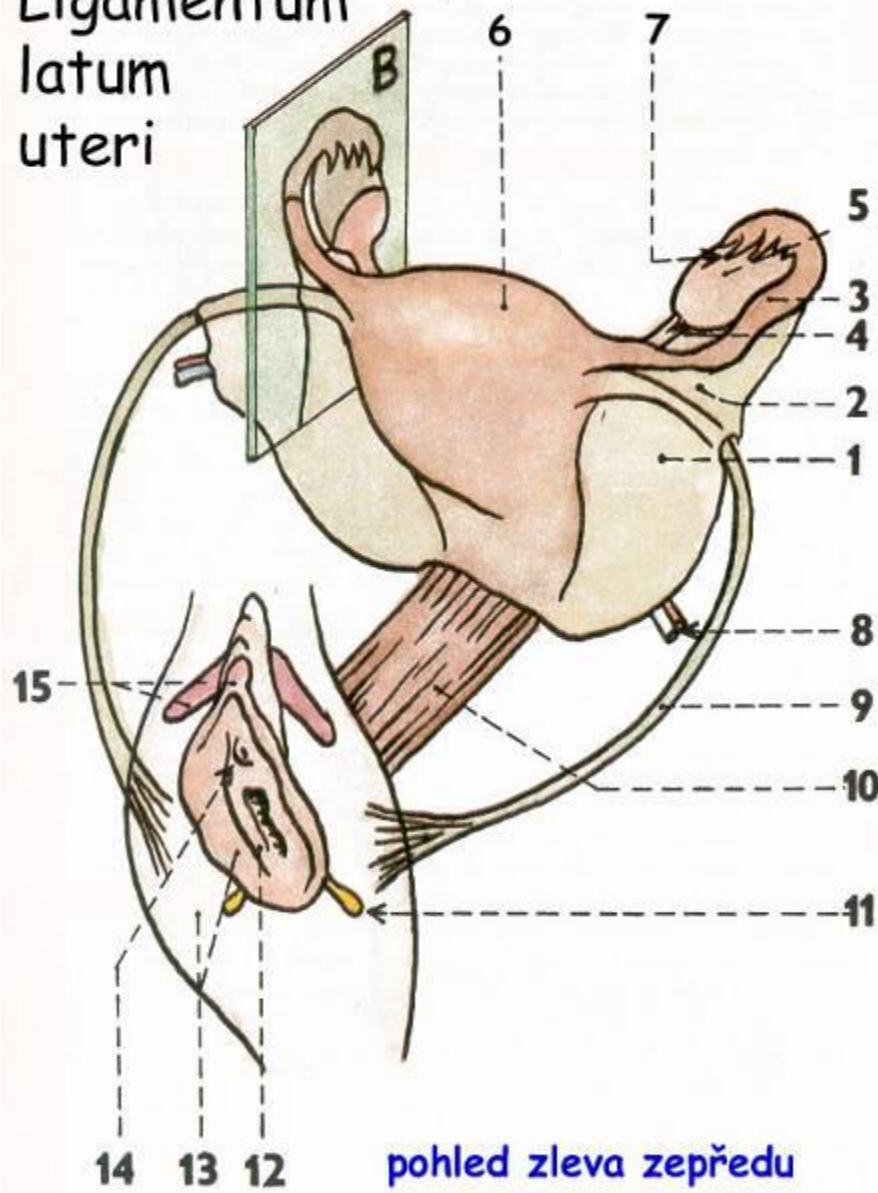


# Female internal genital organs

## *Organa genitalia feminina interna*



Ligamentum  
latum  
uteri



- 1 / ligamentum latum uteri
- 2 / mesosalpinx
- 3 / tuba uterina v mesosalpinx
- 4 / závěs ovaria — mesovarium
- 5 / ovarium
- 6 / uterus v lig. latum
- 7 / abdominální ústí tuba uterina
- 8 / a. et. v. uterina
- 9 / lig. teres uteri
- 10 / stěna vaginy
- 11 / glandula vestibularis major
- 12 / vestibulum vaginae
- 13 / labium pudendi majus et minus
- 14 / ostium urethrae externum
- 15 / clitoris

- double-layered peritoneal duplicature
- sagittally oriented plate



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# Ovarium; Oophoron

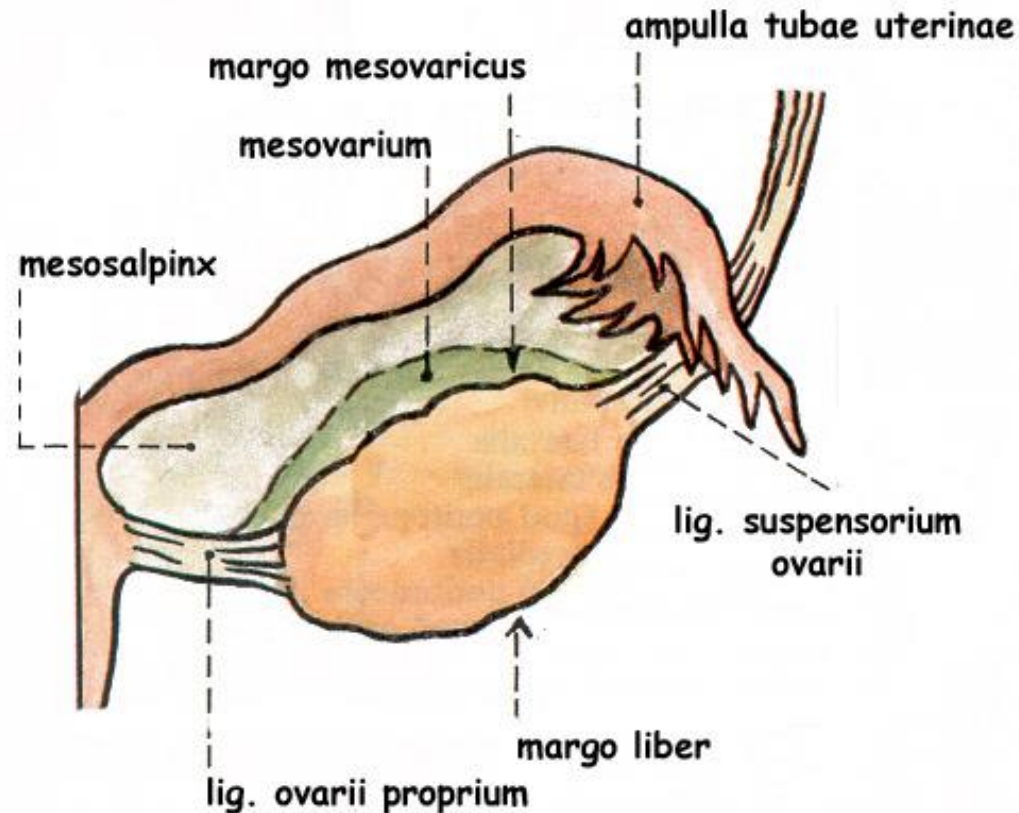
- 6-10 g, flattened shape, large 3 x 2 x 1 cm
- sex gland
  - maturation of ova (ootids)
  - secretion of sex hormones
- intraperitoneal organ
- posterior side of lig. latum uteri
- position: fossa ovarica (*nullipara*)
  - between vasa iliaca externa et interna

fossa of Claudius (*multipara*)

  - between vasa iliaca interna and os sacrum

# Ovary – external structure

- extremitas tubaria
- extremitas uterina
- margo liber
- margo mesovaricus
- facies medialis
- facies lateralis
- hilum ovarii



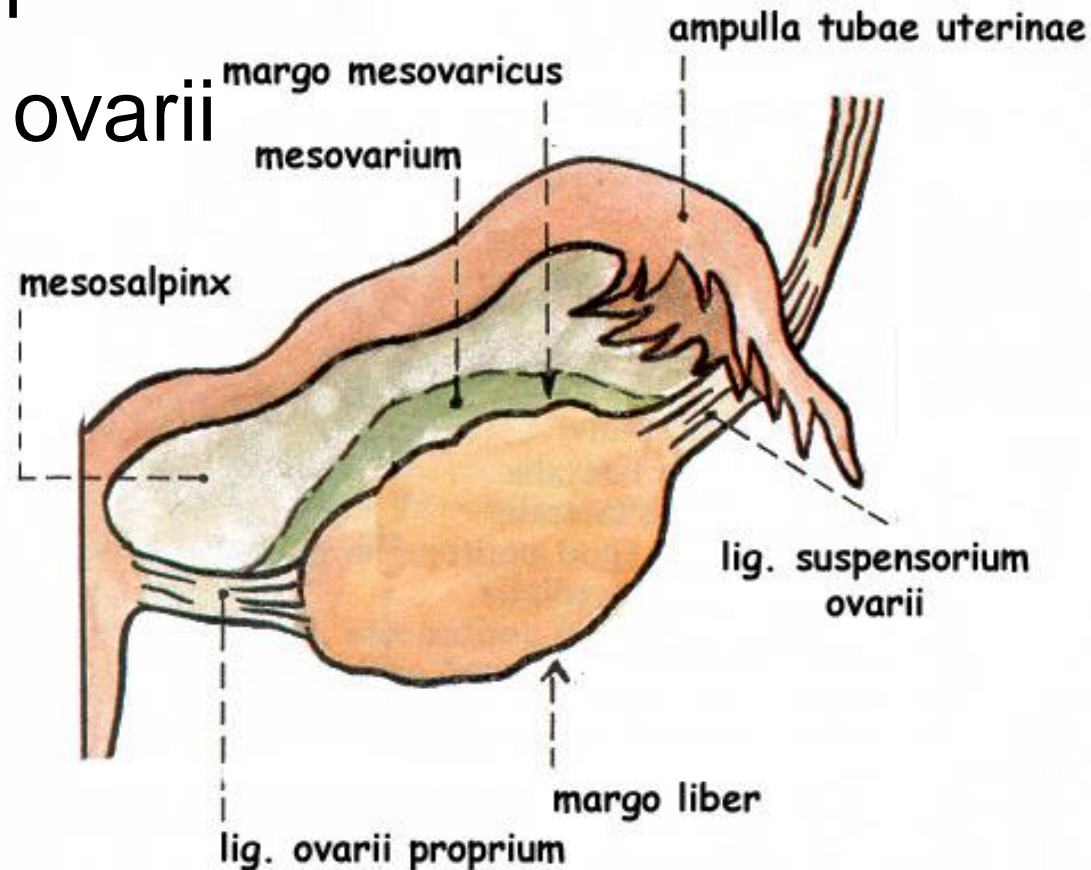
# Peritoneal attachments of ovary and uterine tubes

## Ovary:

- lig. ovarii proprium
- lig. suspensorium ovarii
- lig. latum uteri
- mesovarium

## Uterine tube:

- lig. latum uteri
- mesosalpinx



# Ovary – *blood supply*

all form/to the level of **L2**

Arteries:

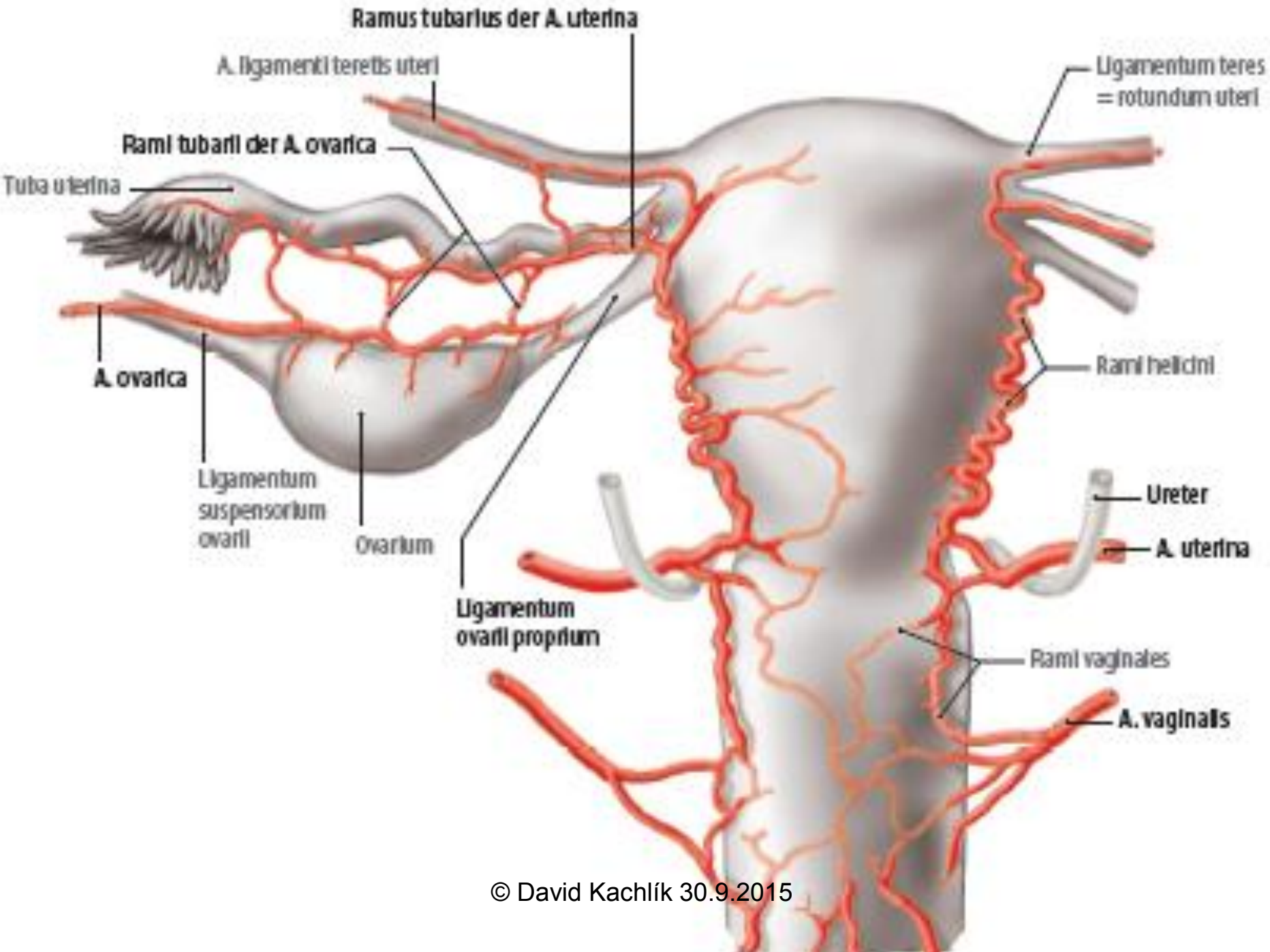
- aorta abdominalis → a. ovarica
- a. iliaca int. → r. ovaricus

*arteries anastomoses to form the ovarian arcade*

Veins: plexus pampiniformis (rudimentary) →  
v. ovarica → v. cava inf. (dx.) / v. renalis  
sin. (sin.)

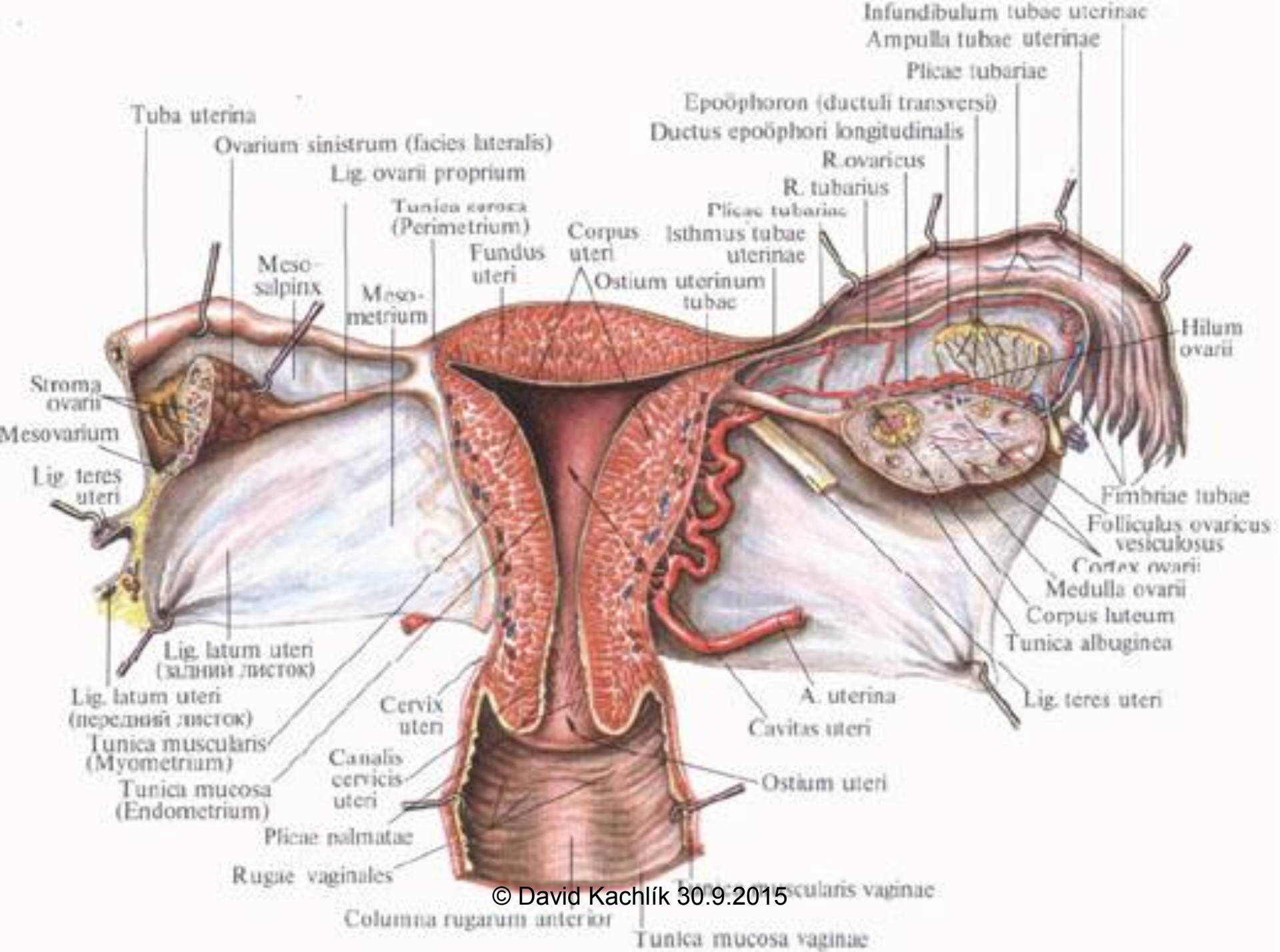
Lymph: n.l. lumbales





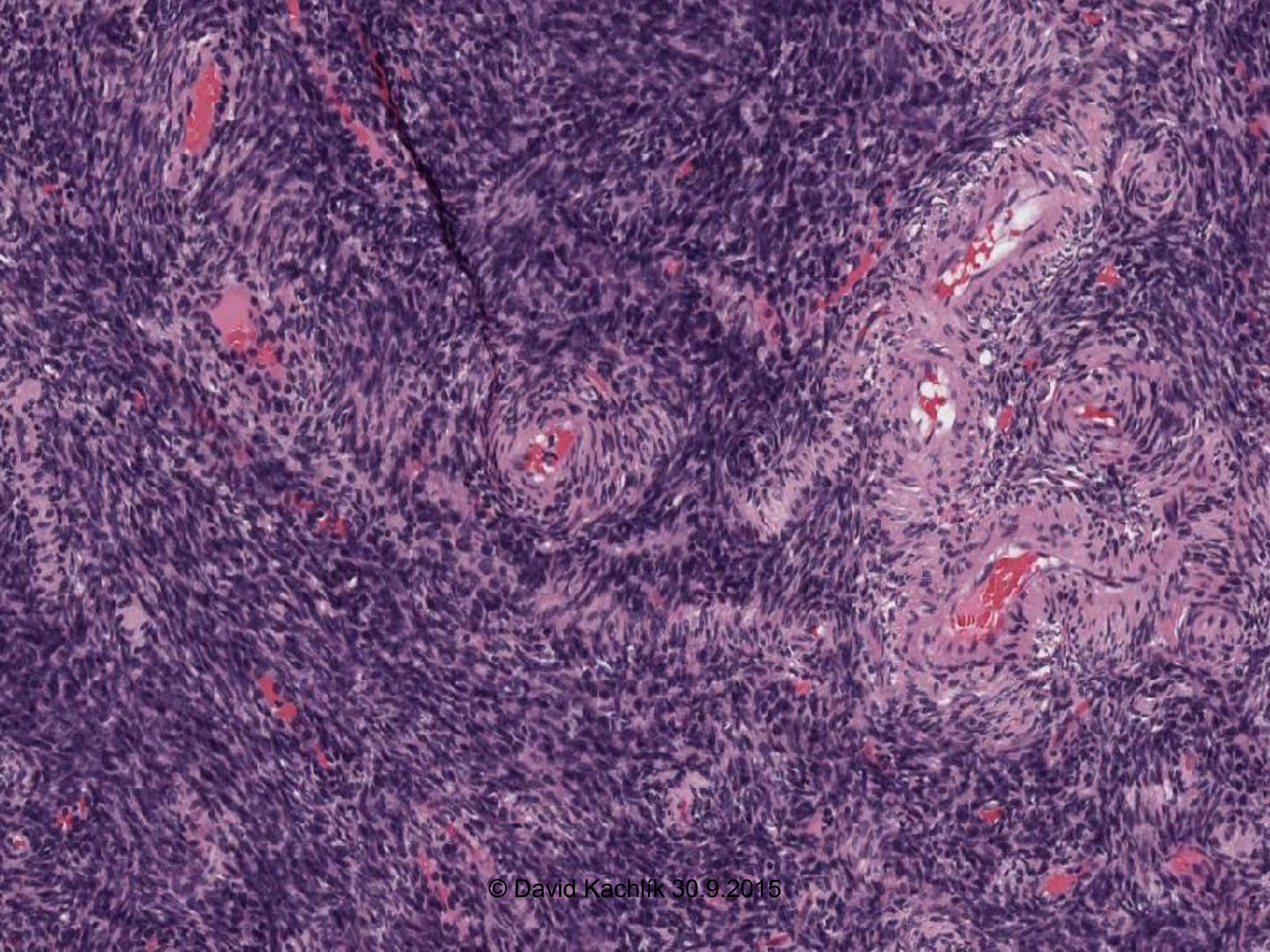
# Ovary – *internal structure*

- superficial (Müllerian) epithelium – simple cuboidal with microvilli
  - original coelomic epithelium (*mesothelium ovaricum*)
  - borderline with mesothelium = linea of *Farre-Waldeyer*
- tunica albuginea
- stroma ovarii
  - connective tissue (collagen and reticular fibers, fibroblasts)
    - **cortex** – folliculi ovarici
  - corpus luteum, rubrum, albicans
    - **medulla**



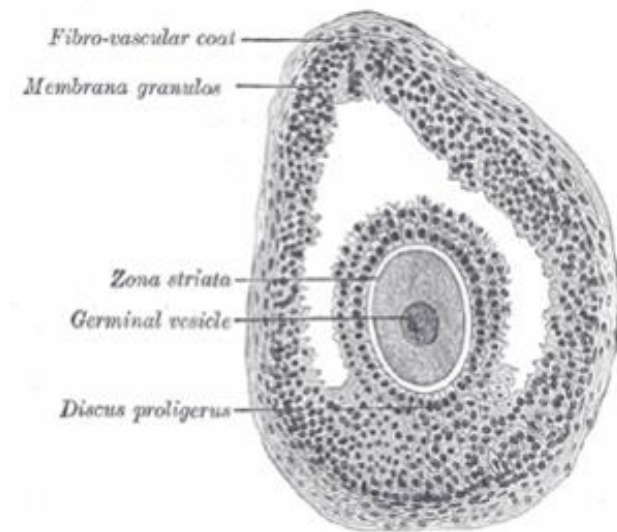
# Ovary – *medulla*

- loose connective tissue
- nerves
- vessels
- groups of endocrine interstitial cells – hilus cells (*cellulae hili*)
  - developmental alternative of Leydig cells
  - produce androgens
- does **not** contain follicles



# Follicles (*Folliculi*)

- one ovum (ootid; *ootidium, ovum*)
- surrounded by follicular somatic cells → granulosa cells
- in the late stages of development is formed capsule from stromal cells → theca cells
- development of ovum
- follicle maturation



# Development of ovum = oogenesis 1.

- two phases:
  - phase of division (mitotic divisions)
  - phase of maturation (meiotic divisions)
    - each ovum in different stage of development → various phases of maturing follicles in ovary
- germ cells proliferate in medullary cords and differentiate into oogonia
- before birth oogonia increase their volume and convert to primary oocytes
  - undergo 1. meiotic division before birth and are arrested at meiotic prophase

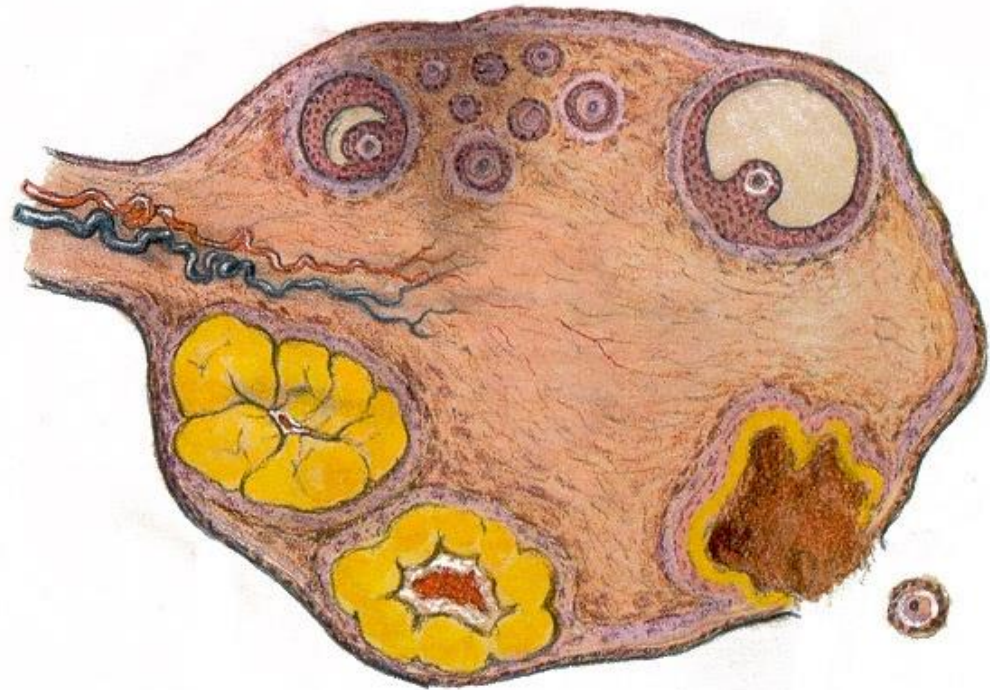
# Development of ovum = oogenesis 2.

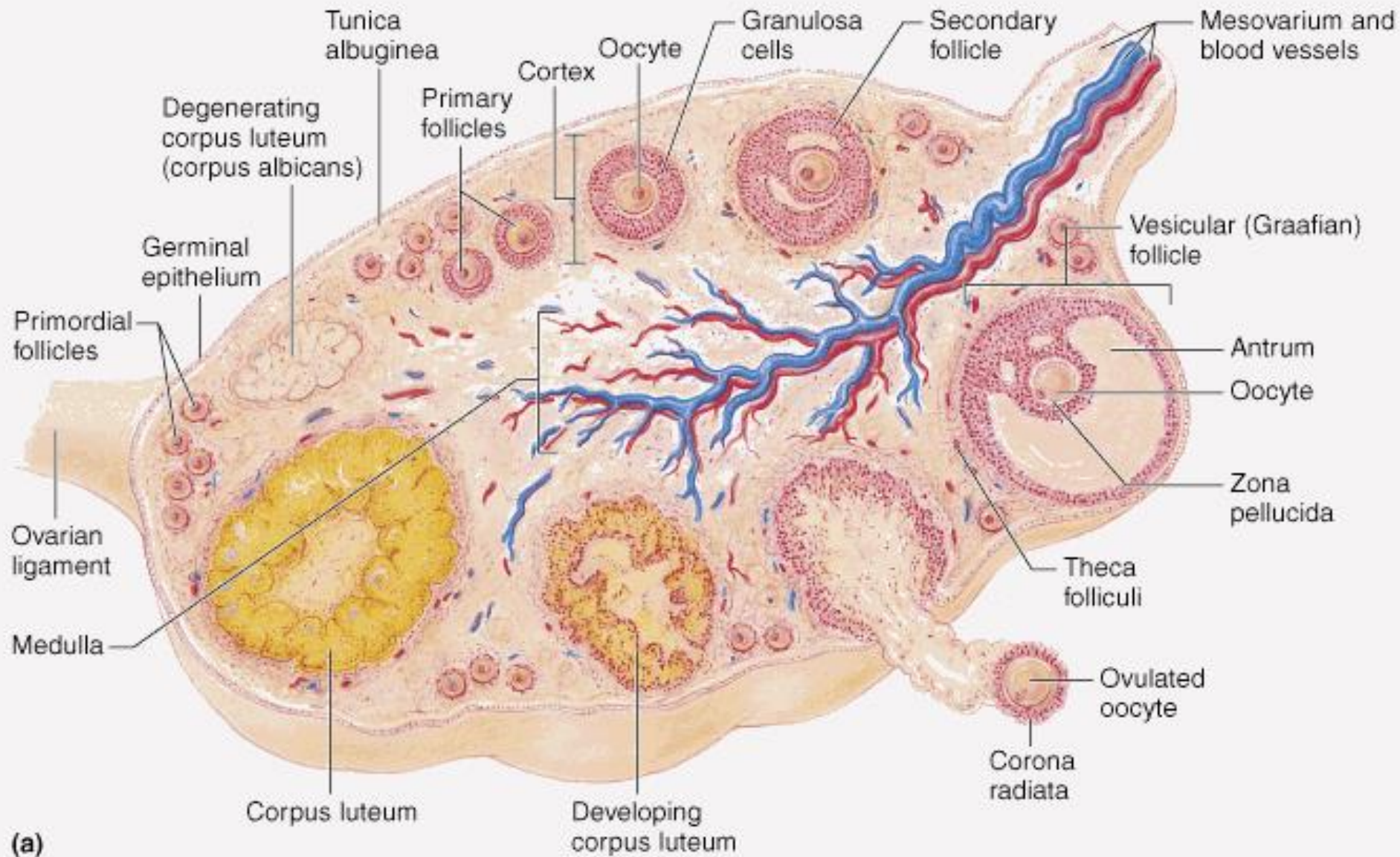
- postnatally from begin of puberty, one or more primary follicles continue in maturation per month
- just before ovulation is finished 1<sup>th</sup> meiotic division → secondary oocyte (+ second polar body / polocyte)
- during ovulation undegoes 2<sup>nd</sup> meiotic division arrested in metaphase
- if fertilization occurs the 2<sup>nd</sup> division is finished and mature ovum develops (+ second polar body / polocyte)



# Follicle stages

- primordial follicle
- primary follicle
- secondary follicle
- tertiary follicle
- matured Graafian follicle

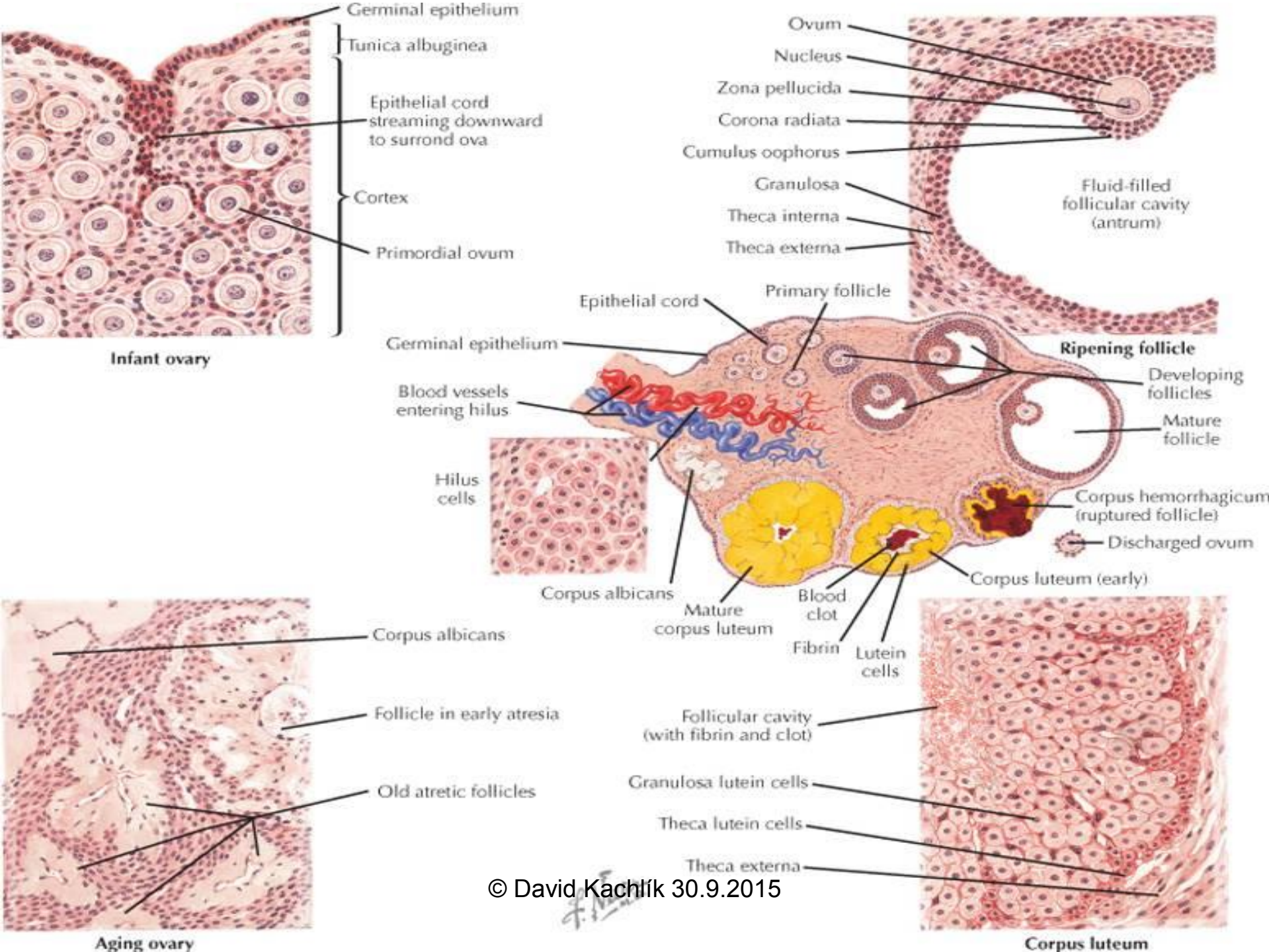




(a)

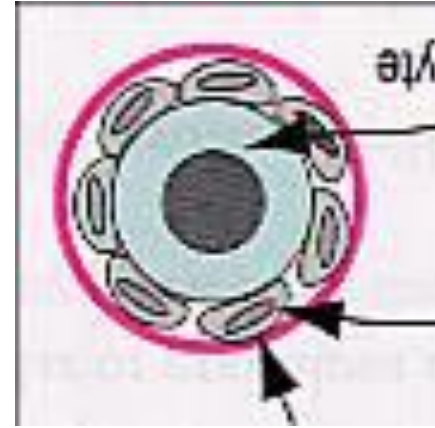
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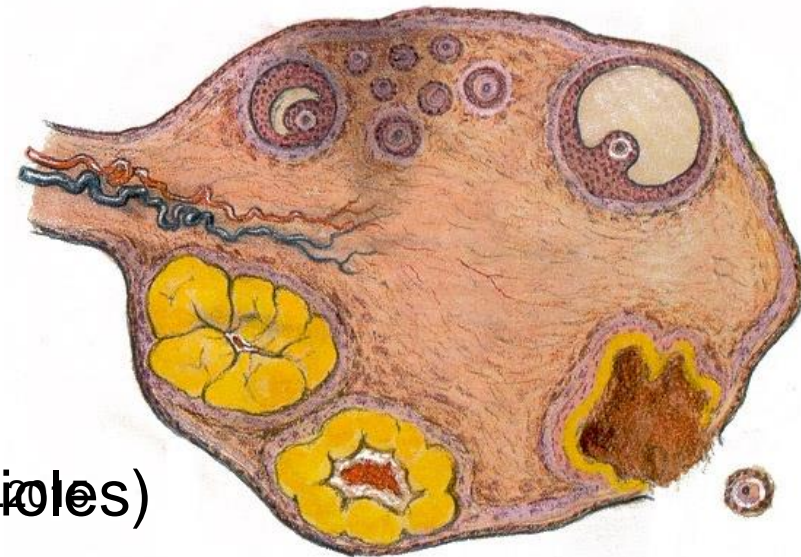


# *Folliculi ovarici primordiales*

## Primordial follicles



- just below the ovarian surface
- one layer of flattened follicular cells  
(*epitheliocyti folliculares; folliculocyti primordiales*)  
= simple squamous epithelium (*epithelium simplex squamosum*)
- oocytus primarius
  - large eccentric nucleus and nucleolus
  - yolk nucleus (Golgi apparatus, mitochondria, inclusions, centrioles)

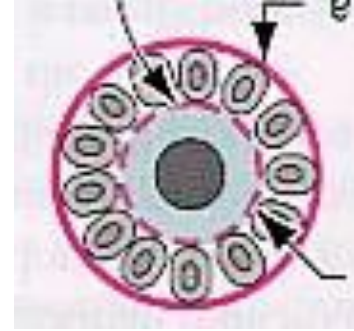




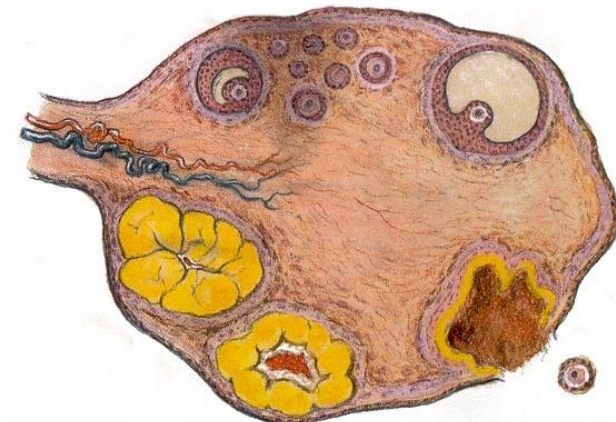


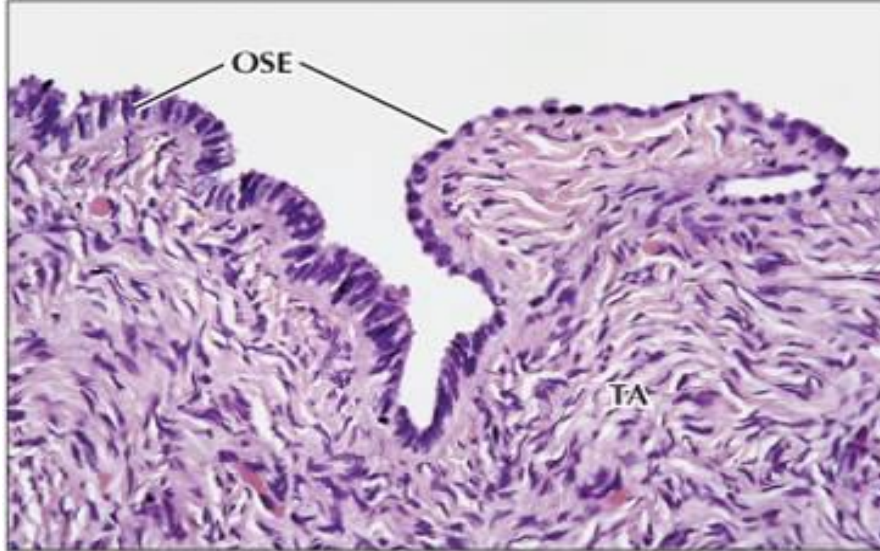
# *Folliculi ovarici primarii*

## Primary follicles

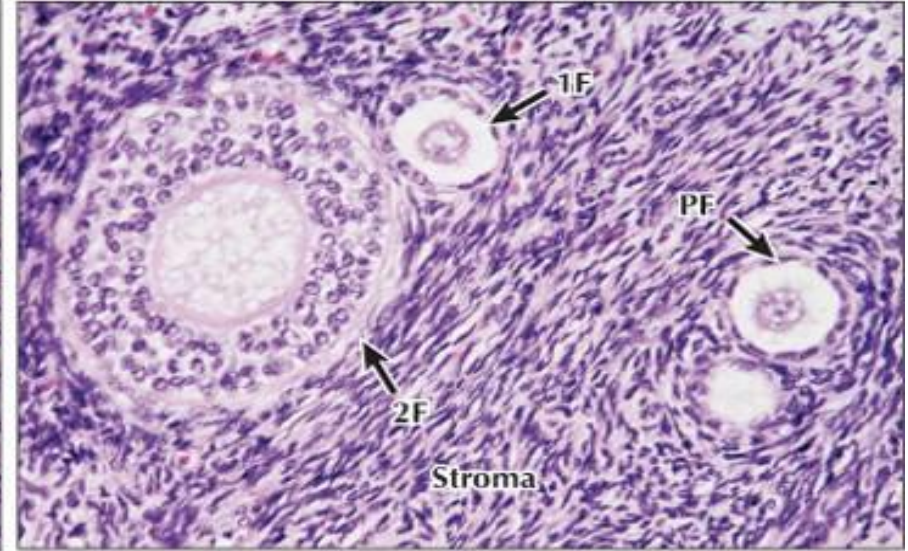


- follicular cells proliferate → simple cuboidal to columnar epithelium (*epithelium simplex cuboideum*)
  - increase of lipid granules → granulosa cells
- *zona pellucida*
  - between cells and oocyte (glycoproteins produced by both populations)

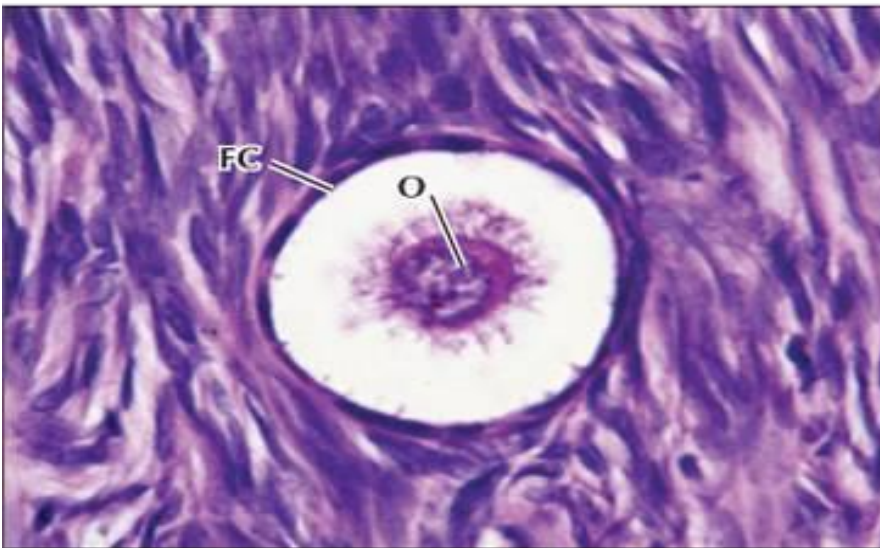




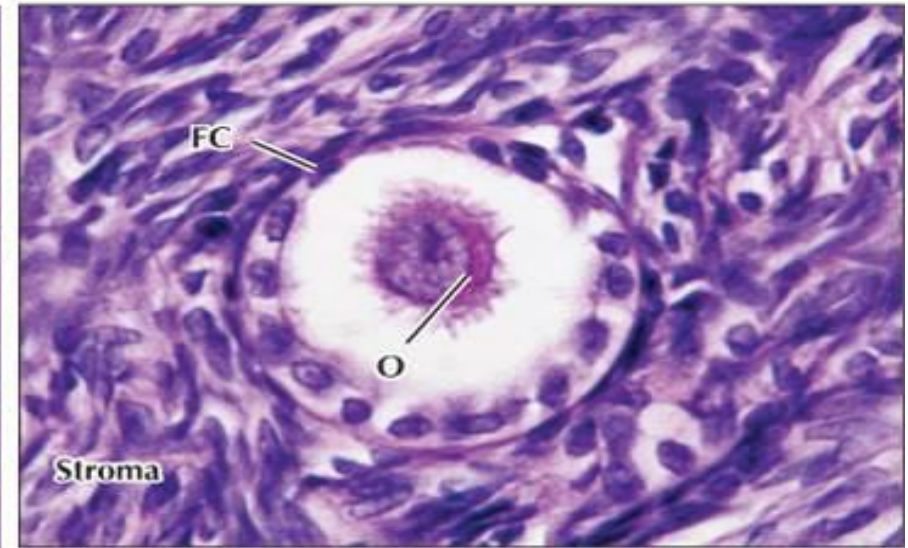
▲ **Light micrograph (LM) of the surface of the ovary.** The ovarian surface epithelium (OSE) consists of one layer of cuboidal to columnar cells. A basement membrane separates them from underlying tunica albuginea (TA). 390×. H&E.



▲ **LM of part of the ovarian cortex.** Markedly cellular connective tissue stroma surrounds primordial (PF), primary (1F), and secondary (2F) ovarian follicles. 295×. H&E.



▲ **LM of a primordial follicle in the ovarian cortex.** One layer of squamous follicular cells (FC) surrounds a primary oocyte (O). The oocyte has a large vesicular nucleus. The clear space between oocyte and follicular cells is a cell shrinkage-related preparation artifact. 790×. H&E.



▲ **LM of a primary follicle.** One layer of cuboidal follicular cells (FC) envelops an oocyte (O). Surrounding stroma is highly cellular and contains elongated cells, some of which will become theca interna cells. The space between oocyte and follicular cells is a preparation artifact. 790×. H&E.

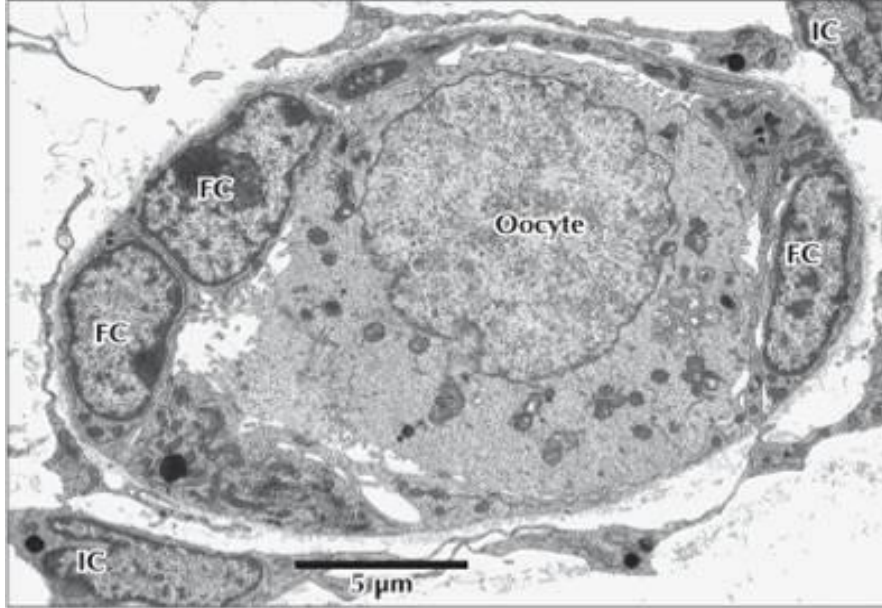




# Primary follicle

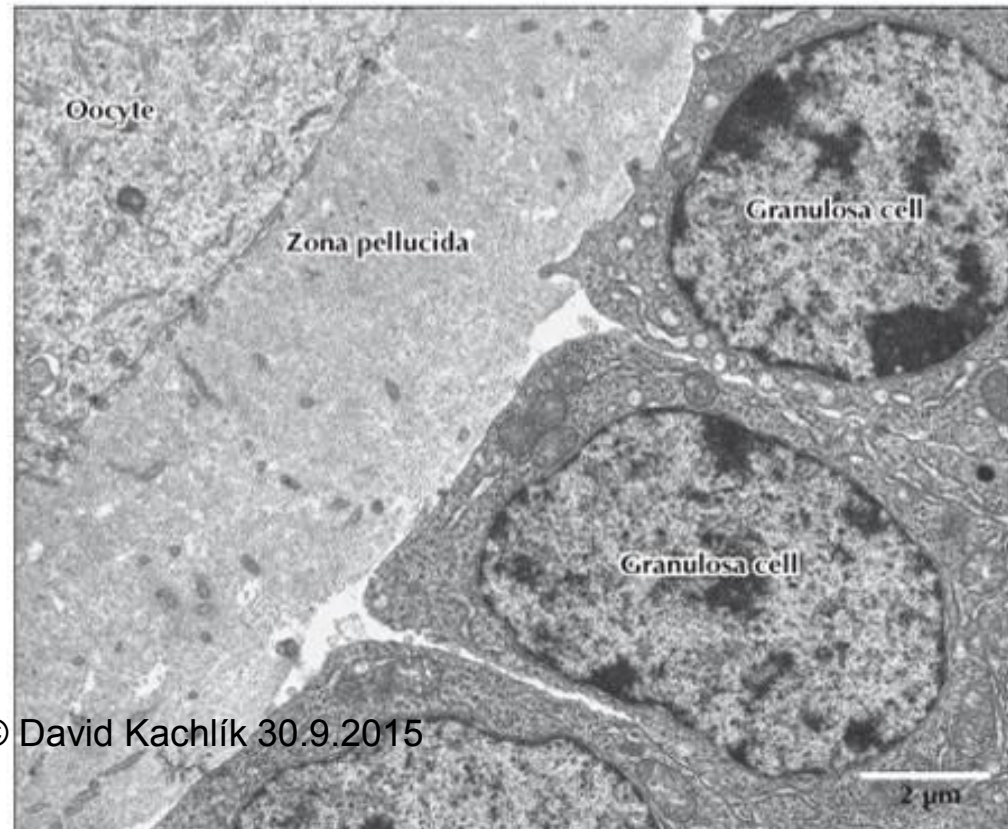
- 1 – folliculus primarius
- 2 – folliculocytii
- 4 – zona pellucida
- 5 – folliculus primordialis
- 8 – textus connectivus interstitialis
- 9 – theca folliculi





◀ **Electron micrograph (EM) of a primordial follicle in a mouse ovary.** Flattened follicular cells (FC) around an oocyte rest on a thin basal lamina; two interstitial cells (IC) are outside the follicle. The oocyte has a smooth surface with occasional small microvilli. Its large euchromatic nucleus has finely dispersed chromatin. A few mitochondria and vesicular structures are seen throughout the relatively pale cytoplasm. 3400×.

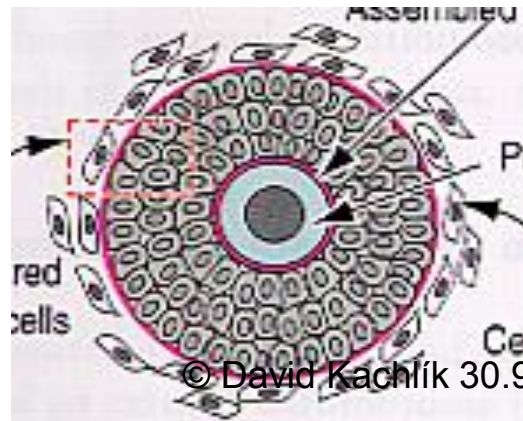
▶ **EM of part of a primary follicle.** The zona pellucida between the oocyte and granulosa cells consists of amorphous material rich in glycoproteins and proteoglycans. It contains profiles of small, irregularly shaped microvilli that emanate from granulosa cells and oocyte. Granulosa cells at this stage contain abundant ribosomes and RER. 6300×.



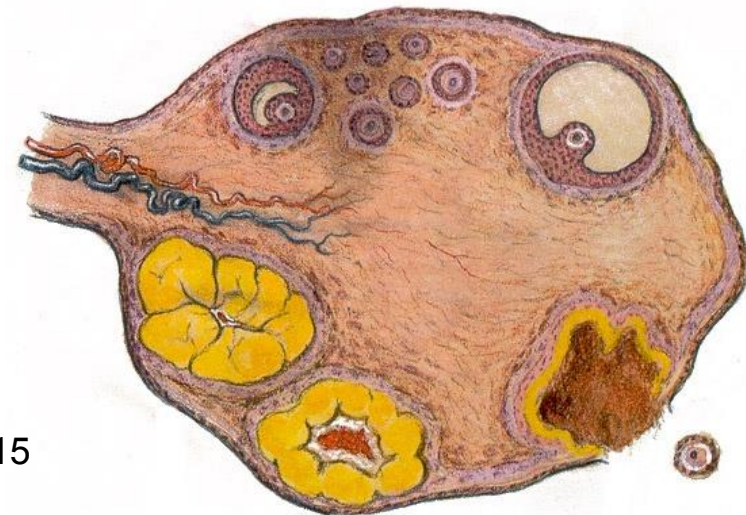
# *Folliculi ovarici secundarii*

## Secondary follicles

- epithelium stratificatum cuboideum
- prominent basal lamina and zona pellucida
- *theca folliculi* (follicular sheath)
  - thickening of adjacent connective tissue and stromal cells



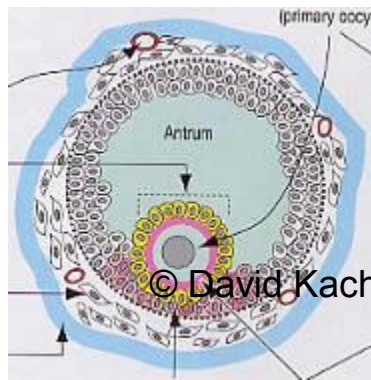
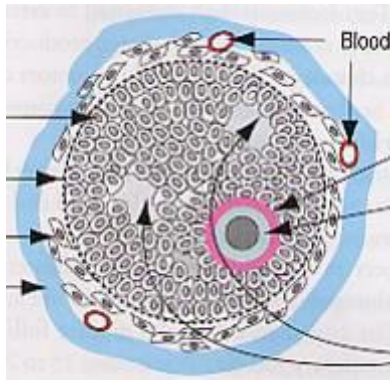
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# *Folliculi ovarici tertiarii / vesiculosi*

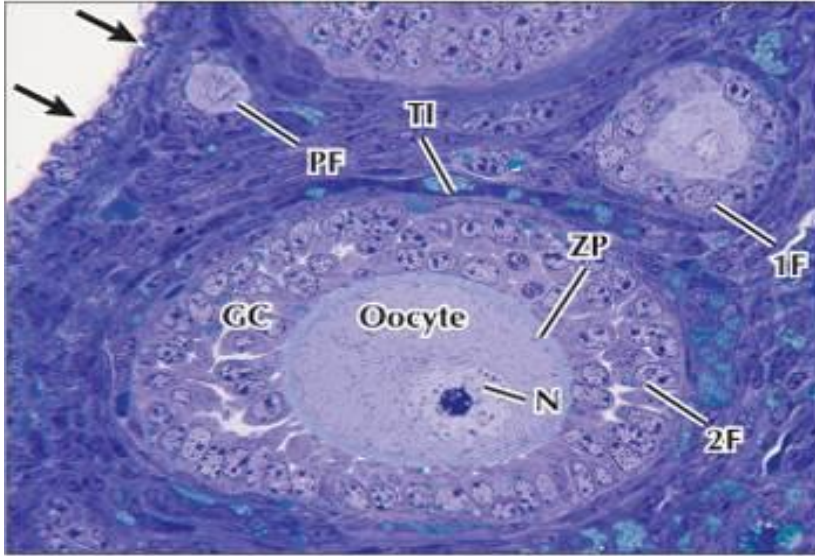
## Tertiary follicles

- 2-5 mm
- Call-Exner's bodies (*corpusculum intercellulare*) → cavities between follicular cells → coalesce to form one cavity (*antrum folliculi*) filled with fluid (*liquor folliculi*)
- granulosa cells (*epitheliocytii granulares; folliculocytii granulares*) form stratified epithelium = **granulosa**
- oocyte located peripherally (*cumulus oophorus*) surrounded by *zona pellucida* and outward by granulosa cells (*corona radiata*)
- theca folliculi differentiates into:
  - → **theca interna** → vessels + theca cells (*endocrinocytii thecales*) → estrogens
  - → **theca externa** – connective tissue (*fibrocytii thecales*)



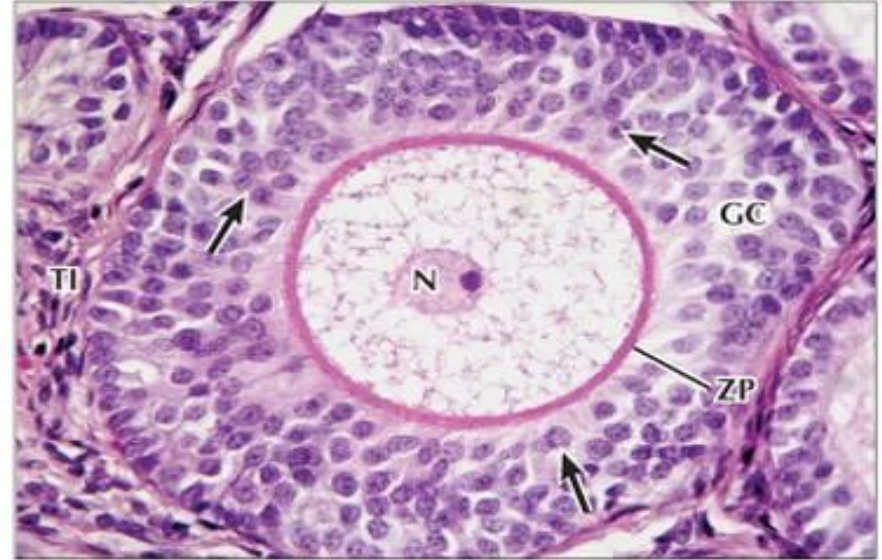
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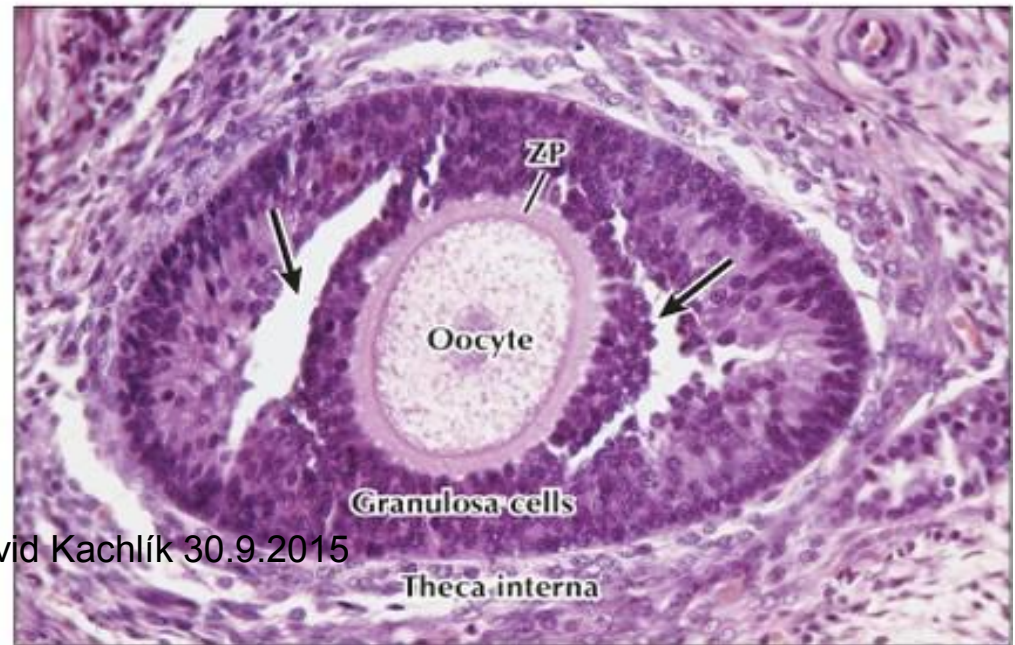


▲ **LM of the cortex of the mouse ovary.** Just under the ovarian surface epithelium (**arrows**) are parts of several follicles at different growth stages, with an oocyte in each follicle. A small primordial follicle (**PF**), a larger primary follicle (**1F**), and a multilaminar secondary follicle (**2F**) are seen. Granulosa cells (**GC**) of the secondary follicle form a stratified layer; those in the other two follicles form a single layer. The oocyte in the secondary follicle has an eccentric euchromatic nucleus (**N**) with a prominent nucleolus. A thin zona pellucida (**ZP**) surrounds the oocyte's plasma membrane. Theca interna (**TI**) cells with small clear lipid droplets are in surrounding stroma close to the follicles. 420 $\times$ . Toluidine blue, semithin plastic section.

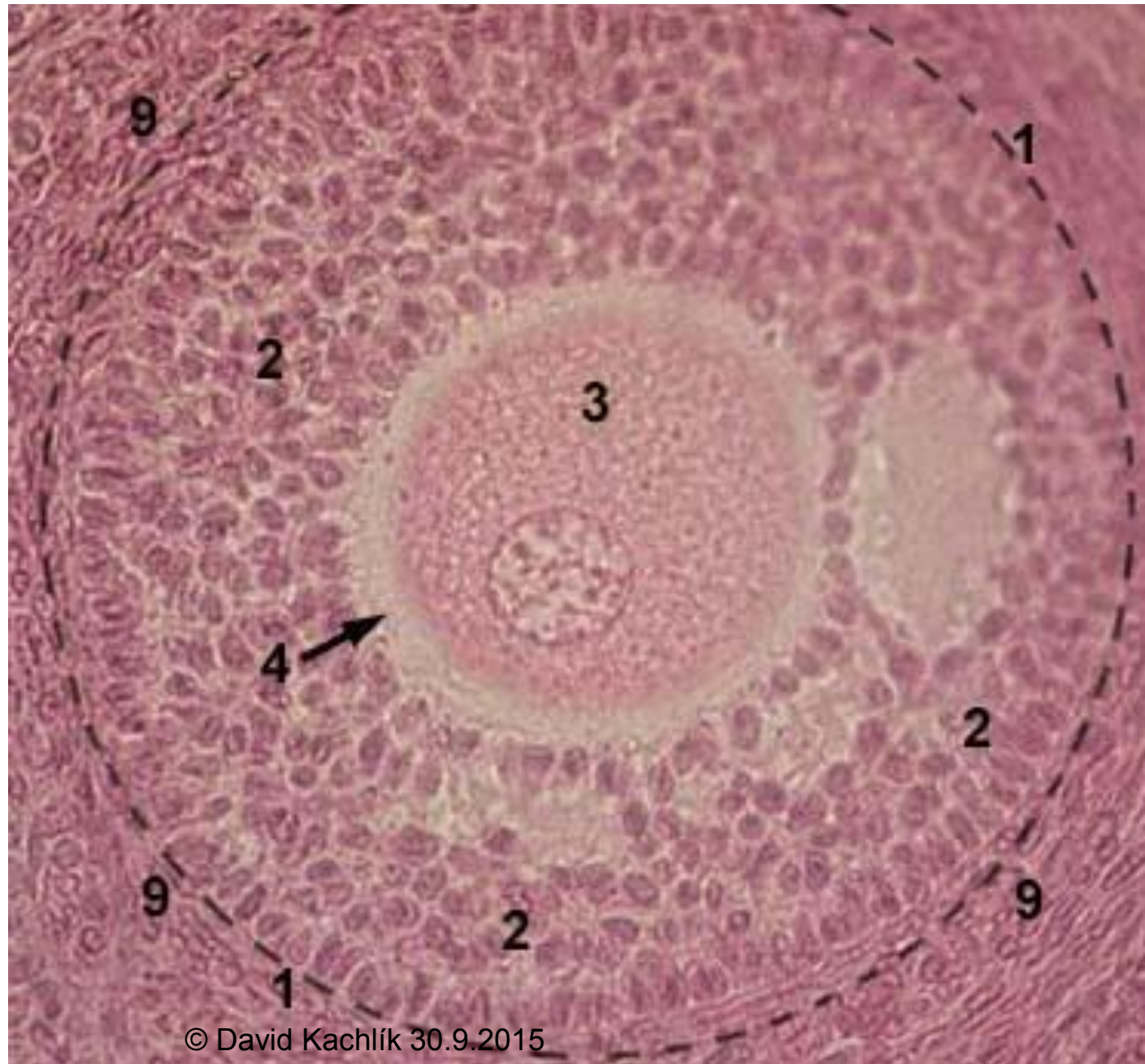
► **LM of a late-term secondary follicle.** Granulosa cells surround the oocyte and its zona pellucida (**ZP**). Next to the outer layer of granulosa cells is a sheath of stromal cells: the theca interna. Several irregular intercellular spaces, or antral lakes (**arrows**), are among the granulosa cells. As the spaces accumulate fluid, they enlarge, become confluent, and give rise to a cavity—the follicular antrum. 270 $\times$ . H&E.



▲ **LM of a preantral secondary follicle.** The euchromatic nucleus (**N**) of the oocyte has a small, prominent eccentric nucleolus. A densely stained, eosinophilic zona pellucida (**ZP**) surrounds pale vesicular cytoplasm. Several layers of granulosa cells (**GC**), some undergoing mitosis (**arrows**), lie concentrically around the oocyte. Surrounding stroma shows early organization into a theca interna (**TI**). 375 $\times$ . H&E.

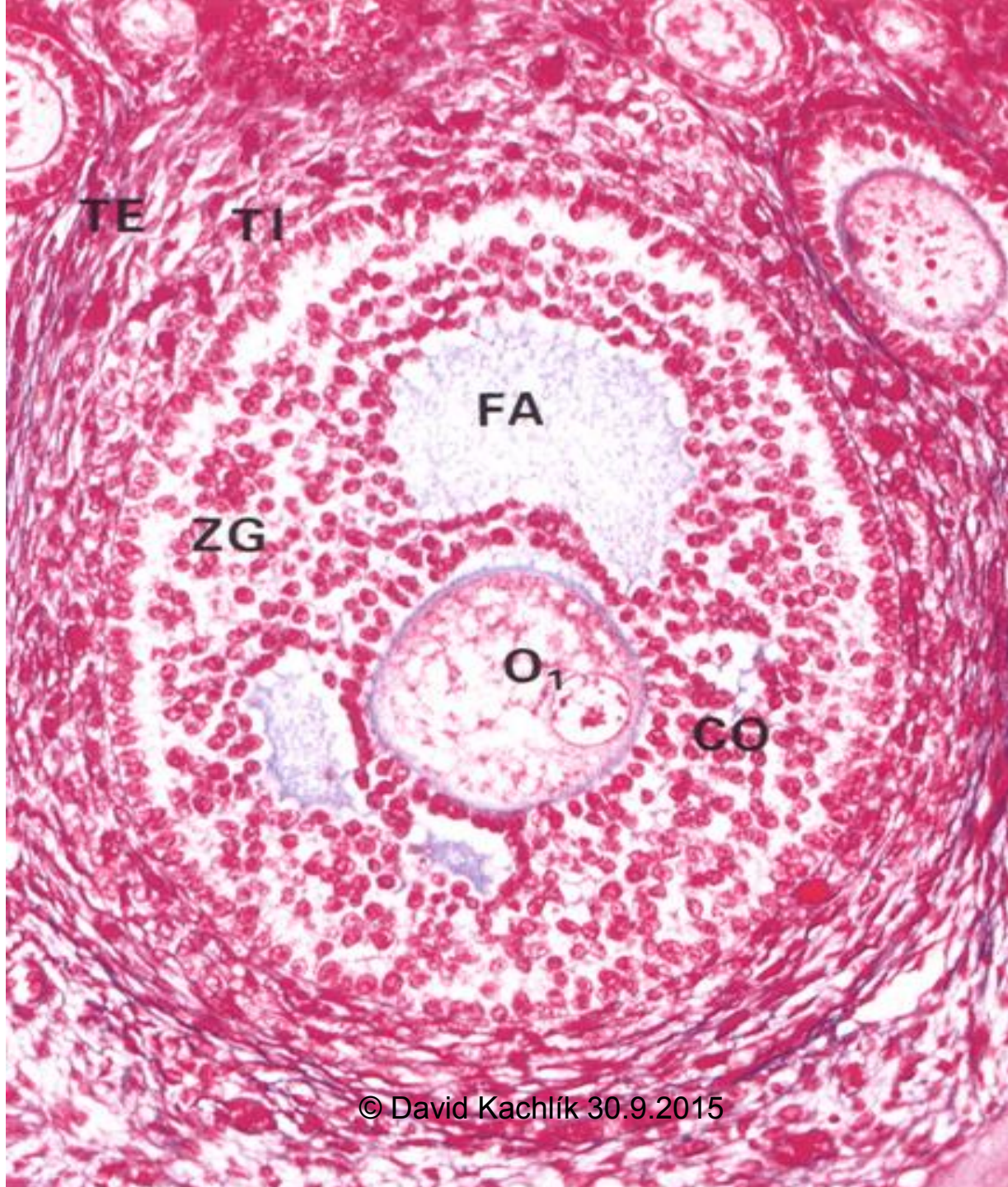


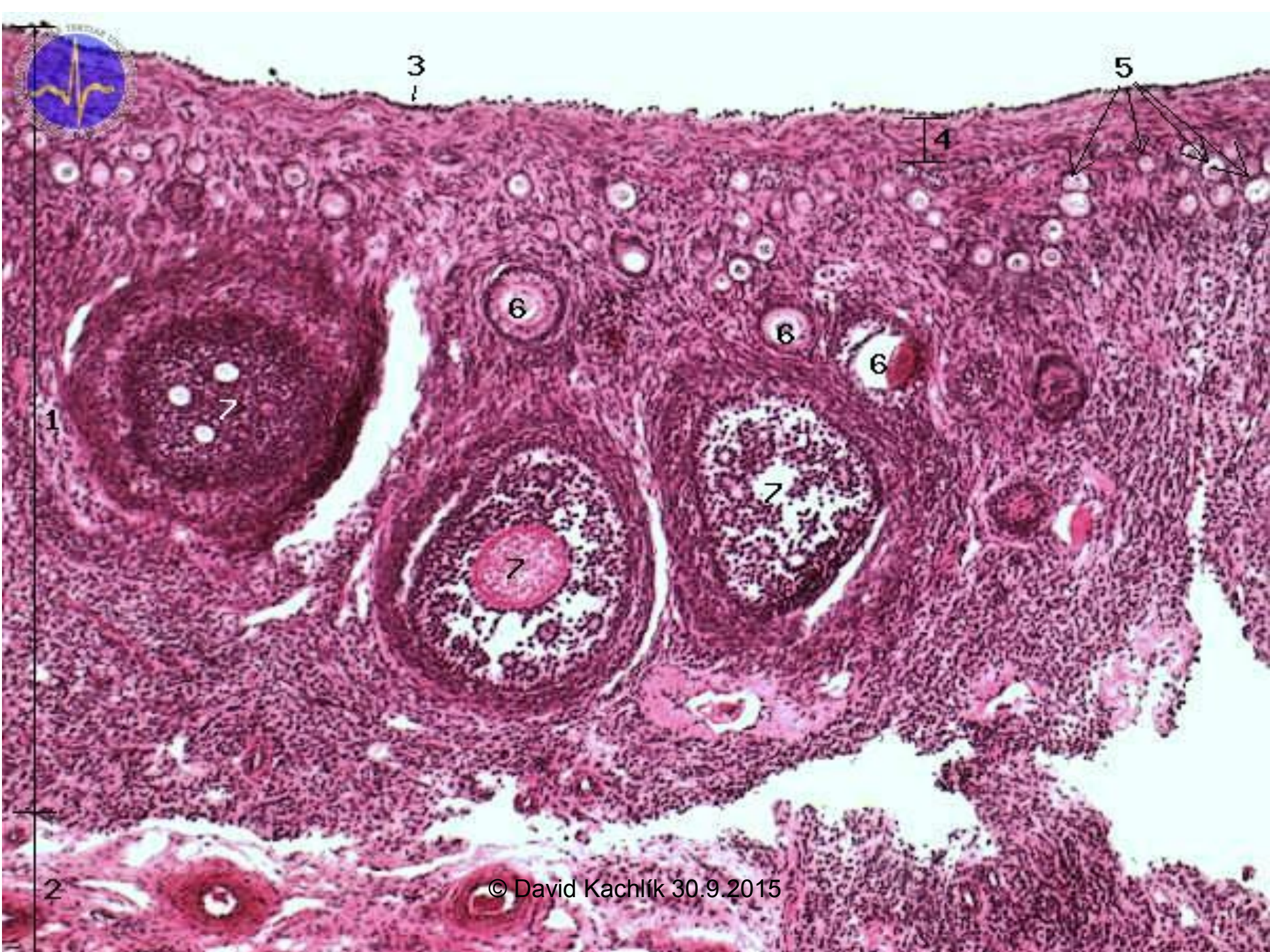
- 1 – folliculus secundarius
- 2 – folliculocytī
- 3 – oocytus
- 4 – zona pellucida
- 9 – theca folliculi



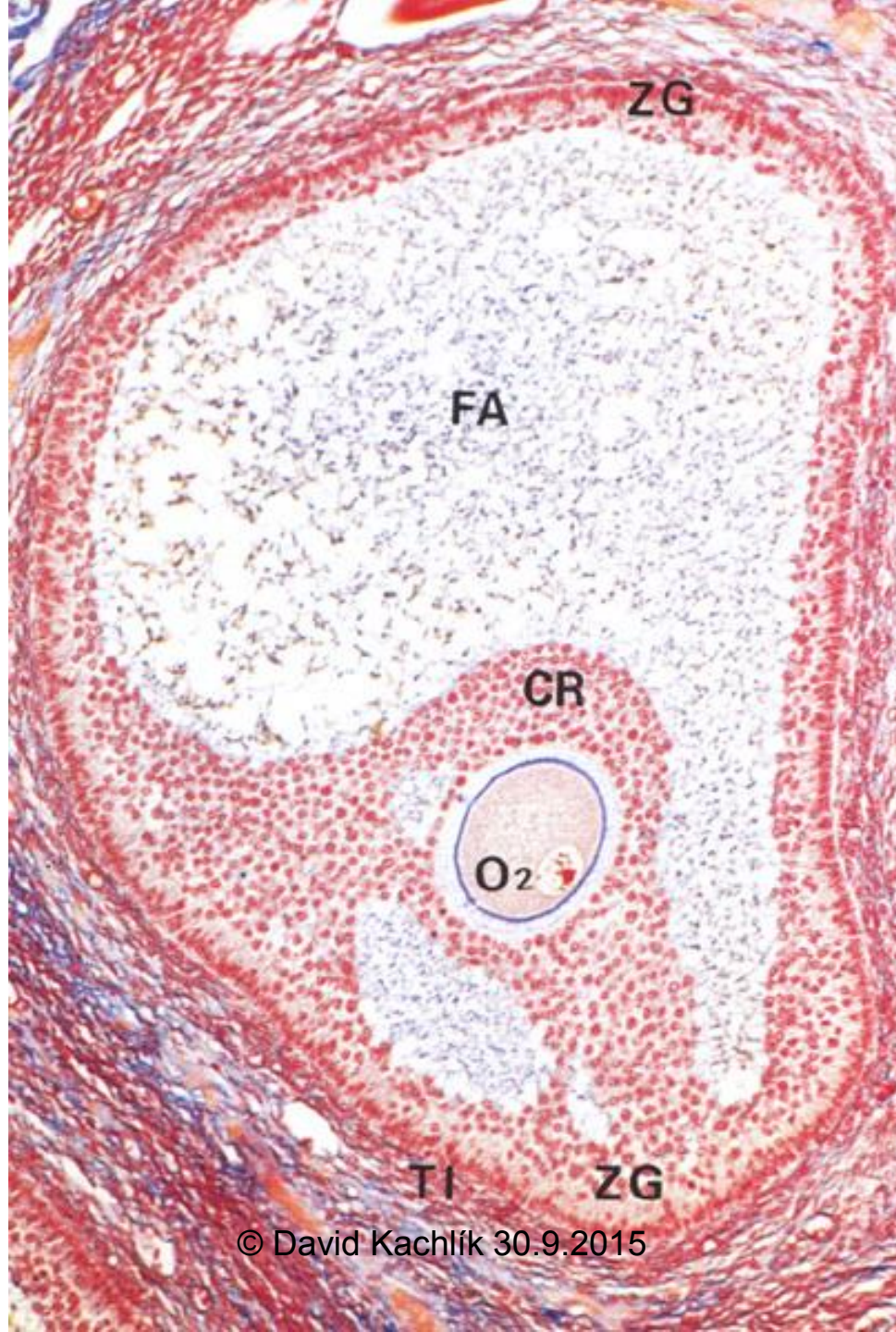


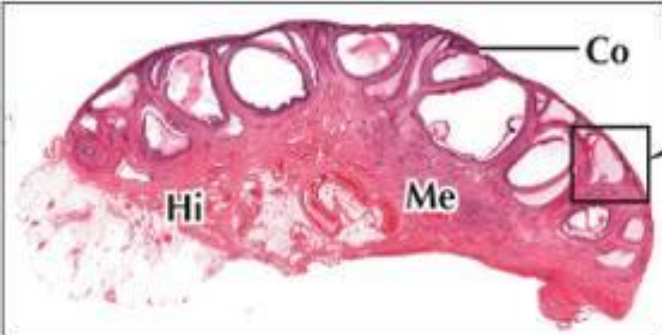








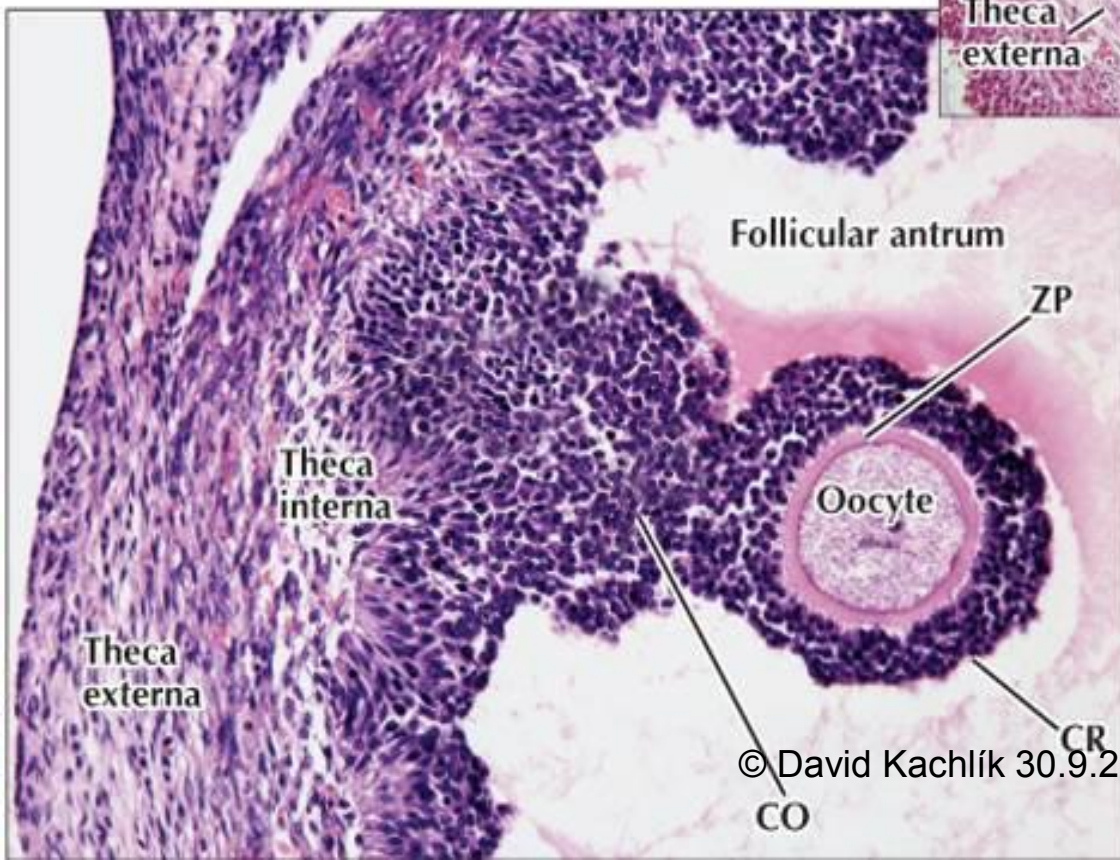




▲ **Low-magnification LM of a mature ovary from a dog.** The outer cortex (**Co**) shows follicles at different maturation stages. The inner medulla (**Me**) contains several blood vessels that enter and emerge from the hilum (**Hi**). 5×. H&E.



▲ **LM of a Graafian follicle.** On one side of the follicle is the oocyte, surrounded by a thin layer of granulosa cells—the corona radiata (**CR**). The oocyte and corona radiata protrude into a large follicular antrum. Around the antrum is a stratified epithelium of granulosa cells, which are enveloped by the thecae interna and externa. 100×. H&E.

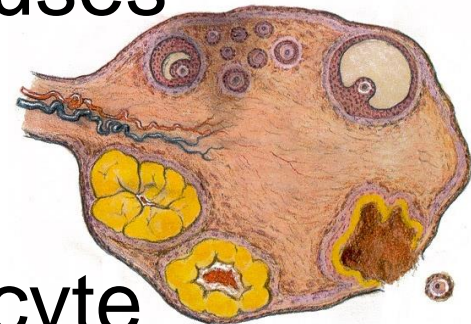


◀ **Higher magnification LM of part of a Graafian follicle.** The oocyte and zona pellucida (**ZP**) are surrounded by a corona radiata (**CR**) that protrudes into a large follicular antrum. The cumulus ophorus (**CO**) is a mass of granulosa cells. The surrounding theca has differentiated into two layers—interna and externa. The antrum contains some occult eosinophilic precipitate. 176×. H&E.

# *Folliculi ovaricia maturi*

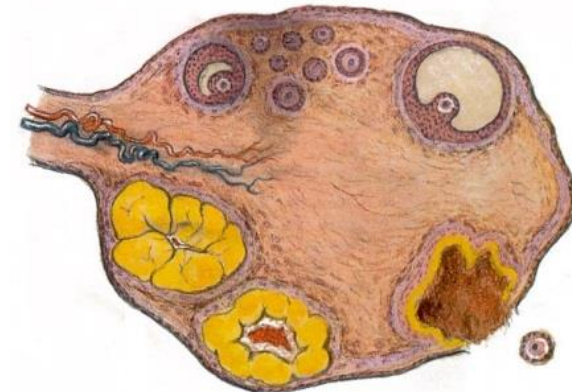
## Matured follicles (Graafian)

- 2-2,5 cm
- oocyte located peripherally (*cumulus oophorus*) and adjacent *granulosa* forms *corona radiata*
- protrudes on surface (*stigma folliculare*)
- thinned capsule and suppressed blood supply
- rapid increase of LH blood level causes rupture of follicle
- finishes 1<sup>st</sup> meiotic division and continues to the 2<sup>nd</sup> → secondary oocyte
- oocyte and *corona radiata* are released



# Luteogenesis

- haemorrhagic body (*corpus haemorrhagicum / rubrum*)
  - antrum folliculi filled with blood
- **corpus luteum**
  - corpus luteum menstruationis
    - 10-12 days (until 24<sup>th</sup>-26<sup>th</sup> day of menstrual cycle) → luteolysis → nothing 😊
  - corpus luteum graviditatis
    - grows under influence of hCG (produced from cytotrophoblast)
    - till the end of 4<sup>th</sup> month of pregnancy → corpus albicans
- corpus albicans
  - fibrous scar, uneven ovarian surface
  - remains for long time
  - after corpus luteum of pregnancy
  - or after degenerated follicles



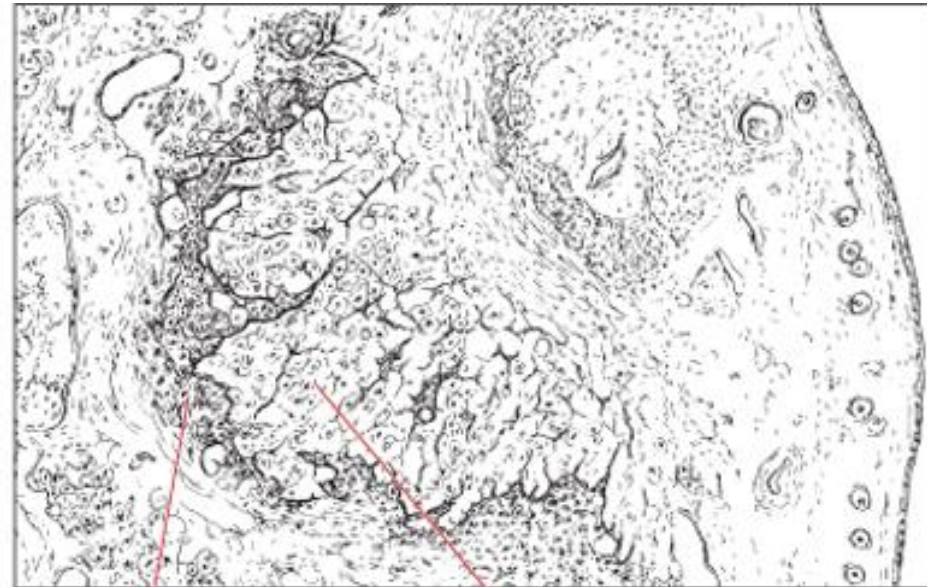
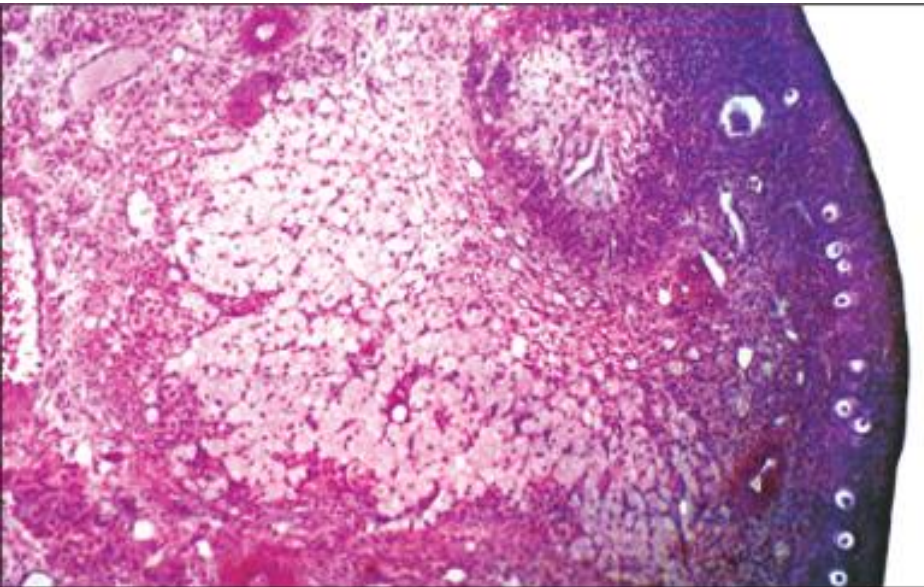
# Corpus luteum

- one-time antrum folliculi contains blood coagulum → converts to the fibrous tissue and constricts remained parts of follicle change after ovulation
- expansion of vessels into granulosa (previously without vessels)
- granulosa lutein cells (*granulosaluteocytī*)
  - production of estrogens from androgens (using aromatase)
  - formation of receptors for LH
  - production of progesterone
- theca-lutein cells (*thecaluteocytī*)
  - production of progesterones and androgens
- progesterone necessary for differentiation of uterine mucosa and persistence of pregnancy
- fibrous capsule (*fibroblasti thecales*)





# Corpus luteum



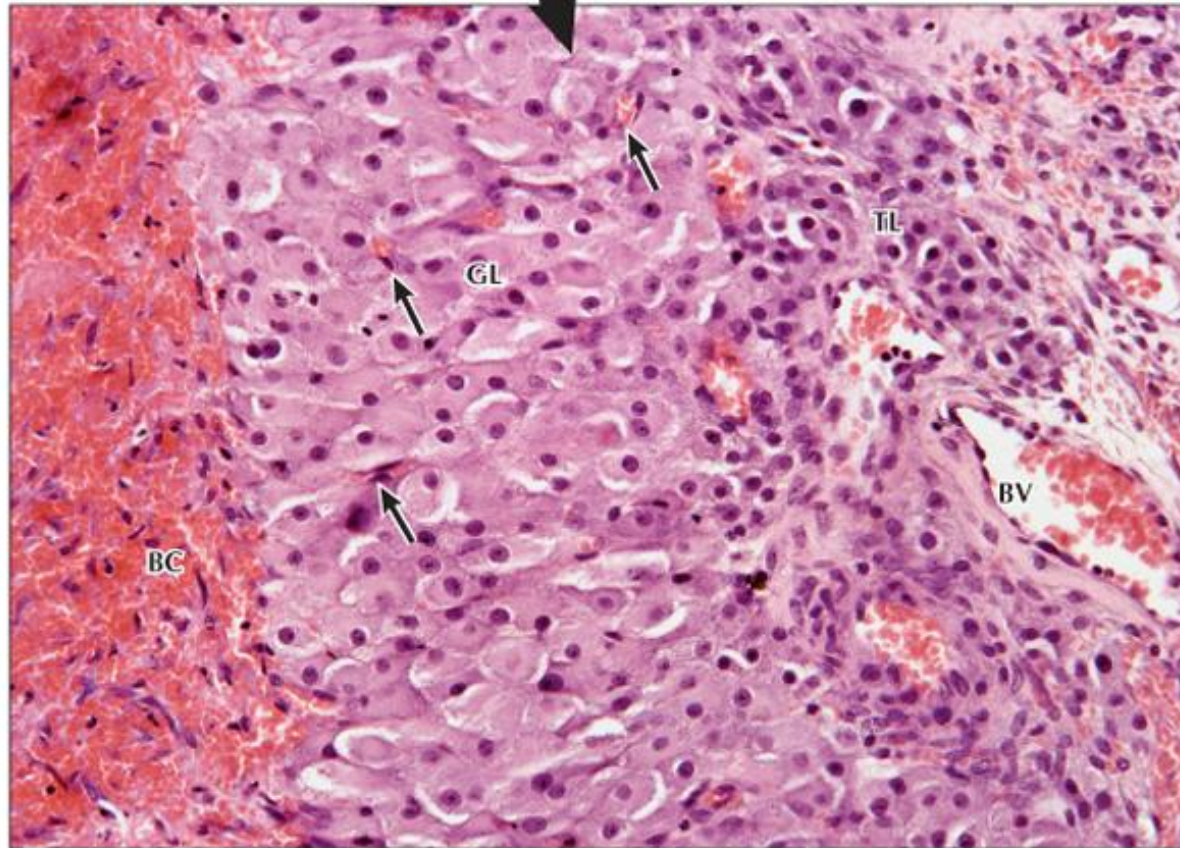
Theca lutein cells    Granulosa lutein cells

Tallitsch: Histology: An Identification Manual.

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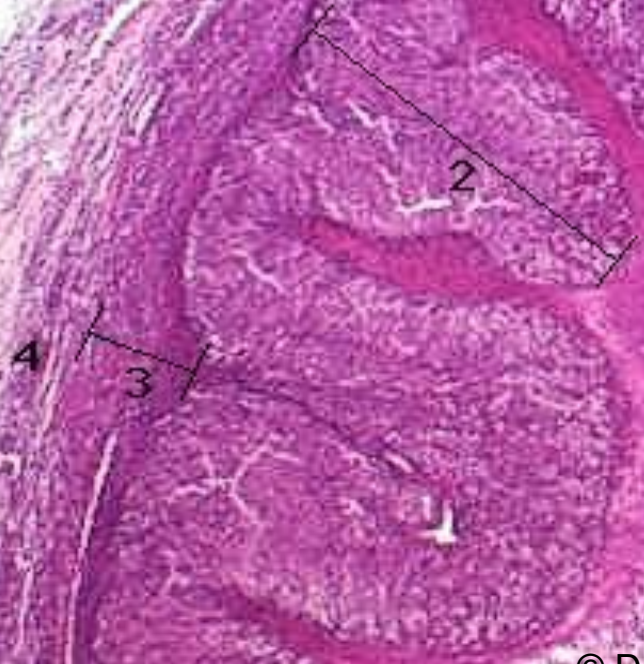


◀ **Low-power LM of the ovary.** The section passes through a corpus luteum. Its outer aspect is highly folded (**circle**) and contains tightly packed granulosa and theca lutein cells, which surround a central cavity (\*) filled with coagulated blood and fibrous scar tissue. 6.5×. H&E.

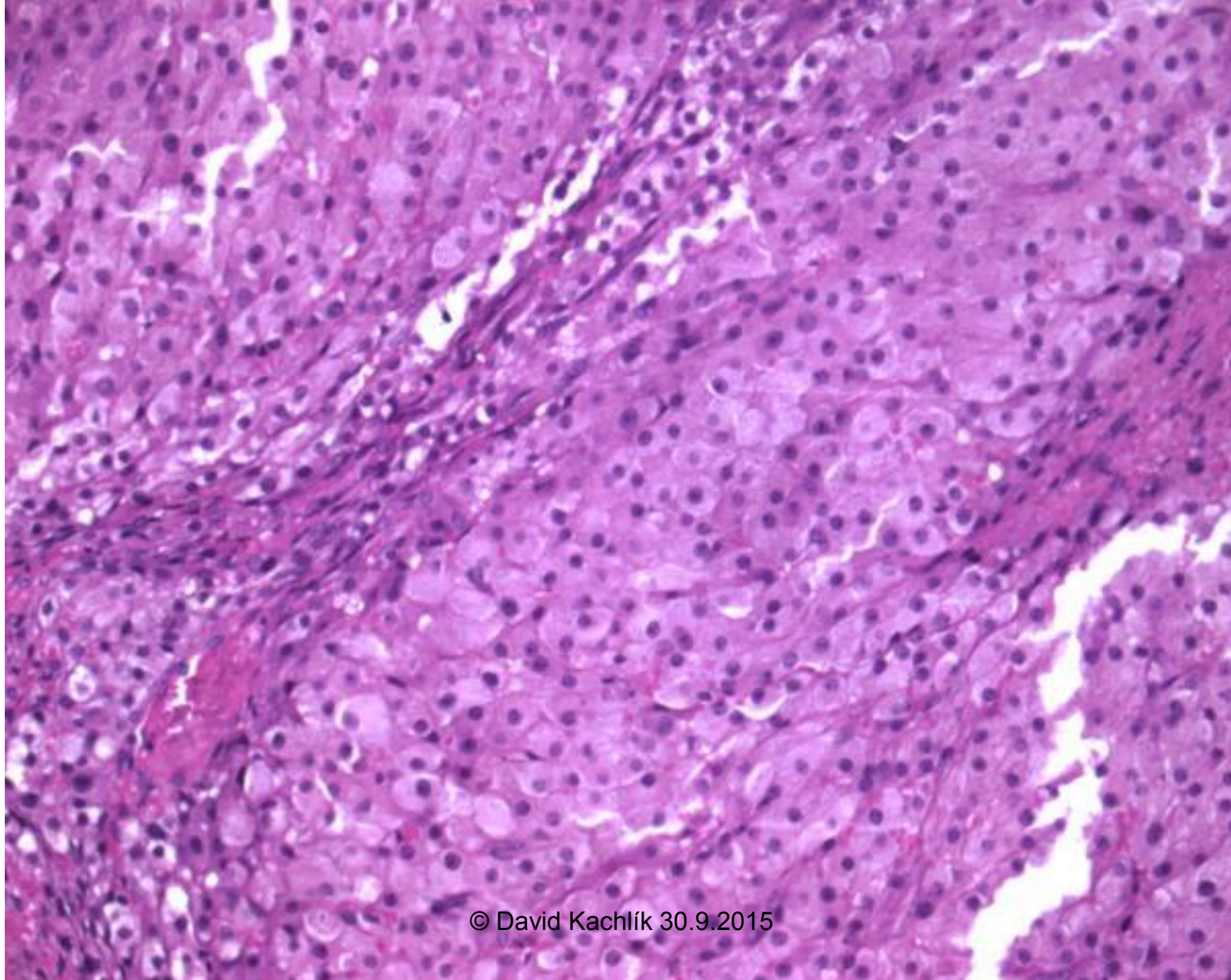


▲ **LM of part of the corpus luteum.** The large, polyhedral granulosa lutein cells (GL) have round nuclei and pale-staining cytoplasm. The cells encroach on a fibrin-containing blood-filled cavity (BC). Peripherally aggregated theca lutein cells (TL) are smaller and have more darkly stained nuclei than do granulosa lutein cells. Blood vessels (BV) are abundant peripherally; capillaries (**arrows**) invade the granulosa layer. 250×. H&E.

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# Ovarian cycle

- follicular phase (1<sup>th</sup>-13<sup>th</sup> day)
  - maturation of follicles
- ovulation (14<sup>th</sup> day)
  - rupture of matured Graafian follicle
- luteal phase (15<sup>th</sup>-28<sup>th</sup> day)
  - corpus luteum period

# Hormonal regulation

- FSH (follicle stimulating hormone)
  - anterior lobe of pituitary gland
  - growth of follicles, maturation of dominant follicle, estrogen production
- LH (luteinizing hormone)
  - final maturation of primary oocyte and begin of 2<sup>th</sup> division phase
  - induction of ovulation, gestagens production
- hormone production under control of GnRH (gonadotropin-releasing hormone)
  - hypothalamus

# Follicle maturation

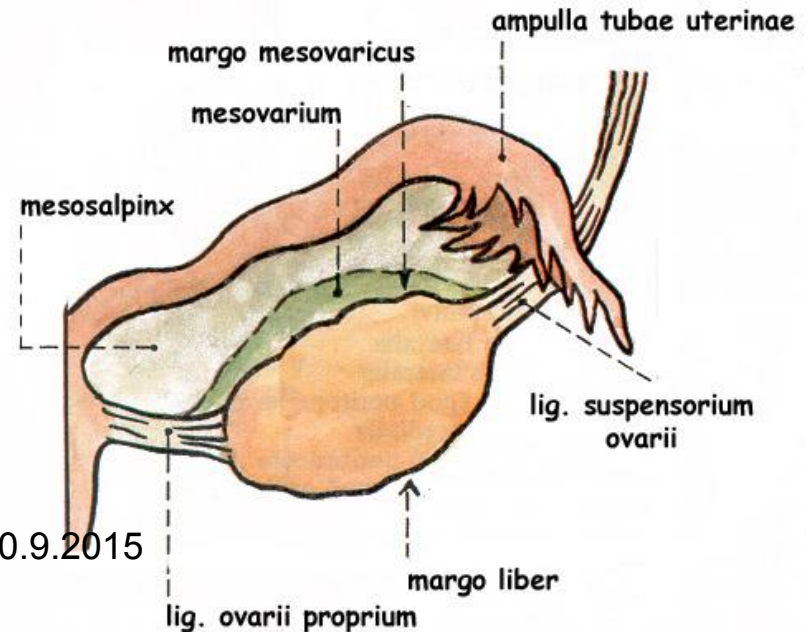
- follicle development (3-6 months) – from primordial to tertiary follicle (gonadotropin-independent)
- follicle maturation (gonadotropin-dependent)
  - Theory of the dominant follicle
  - 10-20 early-stage tertiary follicles under influence of FSH mature → selected 1 (exceptionally 2) with higher sensitivity to FSH → estrogen production decreases by negative feedback the secretion of FSH + secretion of inhibin (decreases production of FSH) → decreasing level of FSH can maintain the most sensitive follicle, the rest degenerates
- atresia (degeneration) of follicles
  - 5<sup>th</sup> month: 7.000.000 follicles
  - birth: 1.000.000 follicles
  - puberty: 400.000 follicles
    - degeneration in adulthood: monthly 1.000 (after 35<sup>th</sup> year of age even more)
  - menopause: 1.000 follicles



# Uterine tube

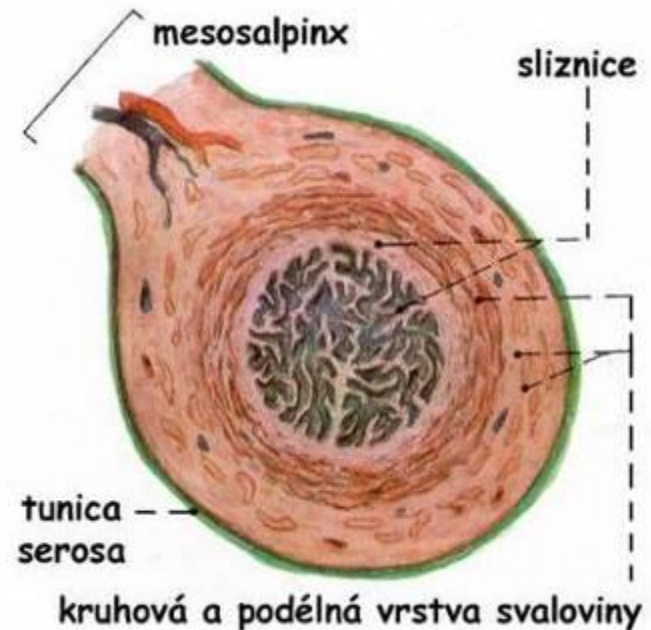
## *Tuba uterina Falloppii; Salpinx*

- parts: ostium abdominale, infundibulum, ampulla, isthmus, pars uterina, ostium uterinum
- opened to the abdominal cavity
- fimbriae
  - the longest fimbria ovarica extends up to the ovary
- 15 cm
- fertilization and first developmental stages of embryo
- transport and nutrition of embrya (4 days)



# Uterine tube – *structure* 1.

- tunica mucosa:
  - simple columnar epithelium
  - folds (*plicae tubariae*), decreasing toward uterus
  - secretory cells (*epitheliocytus tubarius*)
    - protection and nutrition of ovum, production of tubar secretion
  - ciliated cells (*epitheliocytus ciliatus*)
    - movement of secretion and ovum toward uterus
- tunica muscularis: increases
  - inner – circular
  - outer – longitudinal
- tunica serosa (= peritoneum)
  - intraperitoneal organ

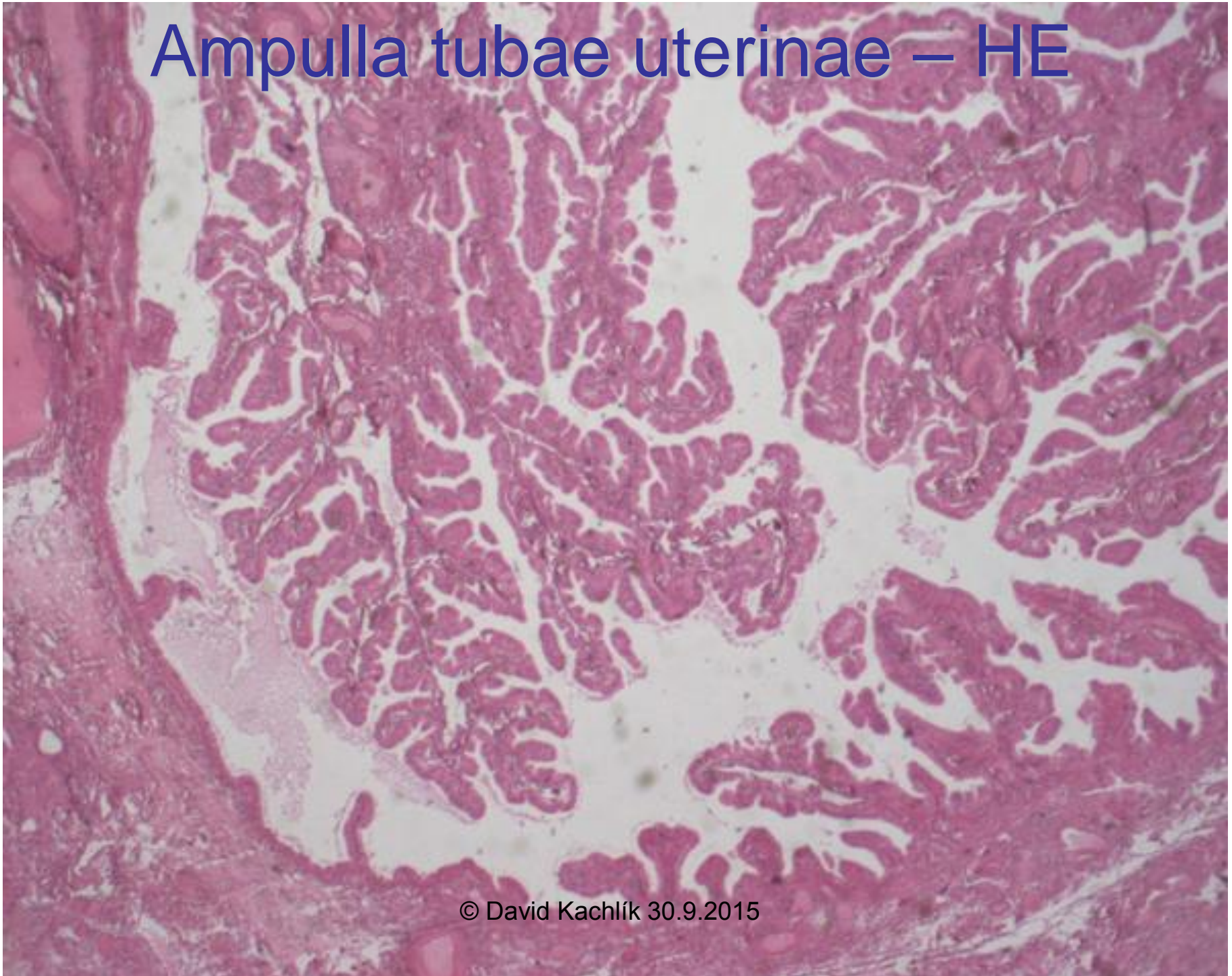


# Uterine tube – *structure 2.*

	Folds	Ciliated cells	Secretory cells	Muscular layers
Infundibulum	+++	+++	+	+
Ampulla	+++	+++	++	++
Isthmus	++	++	+++	+++
Pars uterina	+	+	+++	+++

# Ampulla tubae uterinae – HE

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# Isthmus tubae uterinae – HE

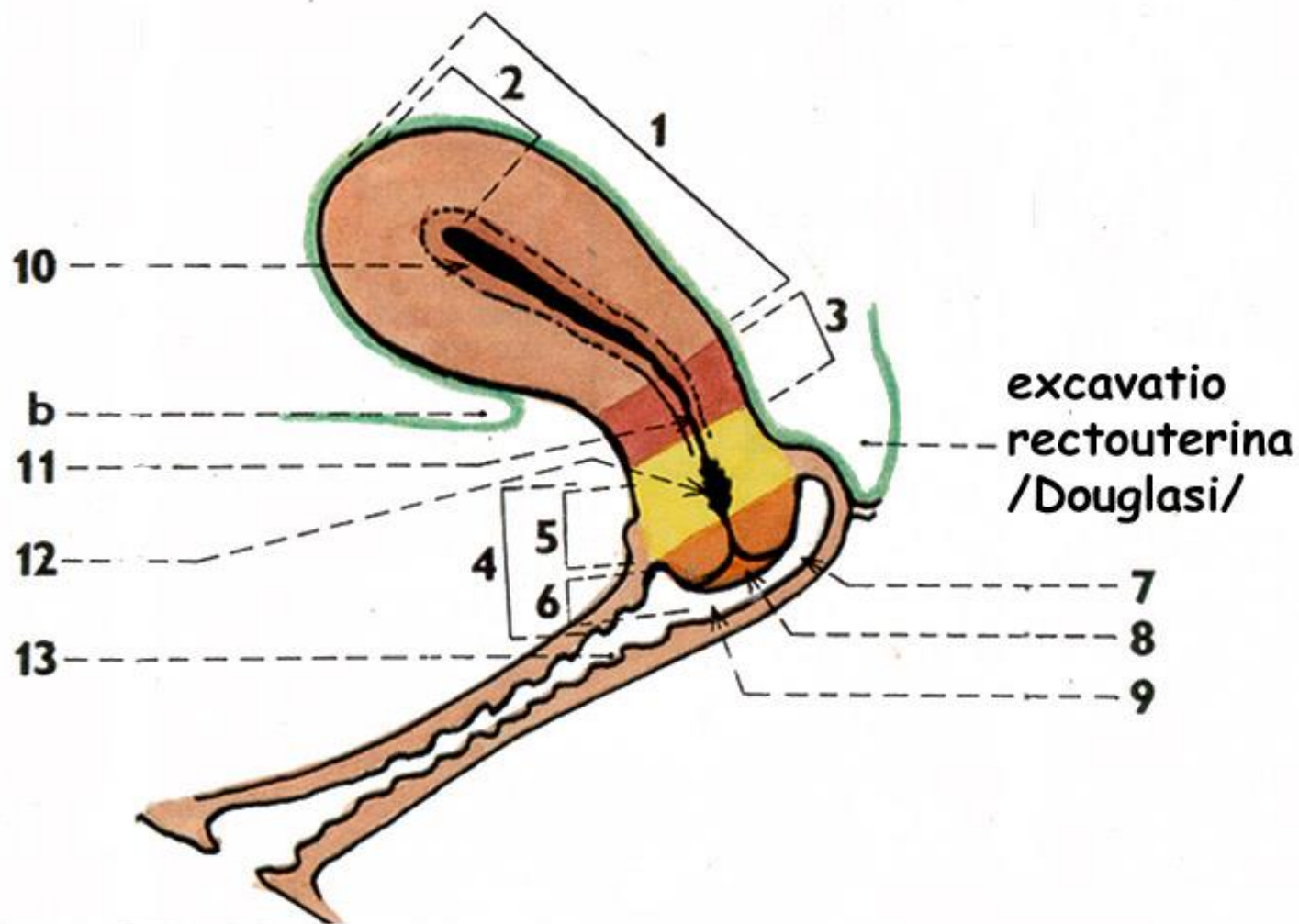


# Uterus (*Metra, Hystera*)

- 8 cm, hollow organ with thick muscular wall
- embryonal and fetal development
- menstrual cycle
- portions:
  - fundus
  - corpus
  - cornu dx. + sin.
  - isthmus
  - cervix
    - portio supravaginalis
    - portio vaginalis (ectocervix)
  - margo dx. + sin.
  - facies vesicalis / anterior
  - facies intestinalis / posterior



# SAGITÁLNÍ ŘEZ DĚLOHOU a POCHVOU



- |  |                             |
|--|-----------------------------|
| 1 / corpus uteri                         | 9 / labium anterius         |
| 2 / fundus uteri                         | 10 / cavitas uteri          |
| 3 / isthmus uteri                        | 11 / canalis isthmi         |
| 4 / cervix uteri                         | 12 / canalis cervicis       |
| 5 / portio supravaginalis cervicis uteri | 13 / vagina                 |
| 6 / portio vaginalis cervicis uteri      | a / excavatio rectouterina  |
| 7 / labium posterius                     | b / excavatio vesicouterina |
| 8 / ostium uteri                         |                             |

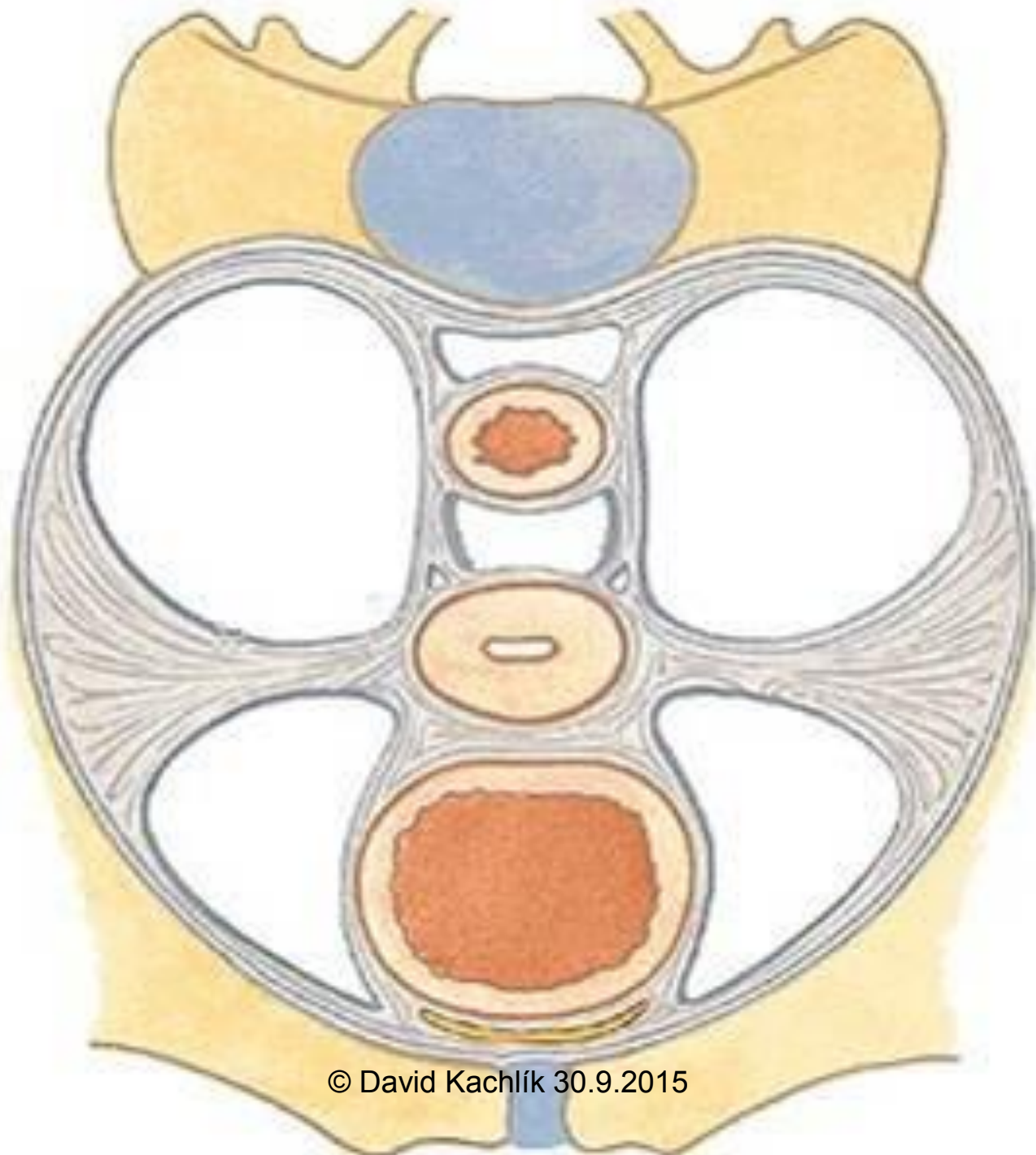


# Uterus – *structure*

- clinical classification: body and cervix
- body – *cavitas uteri*
  - *glandulae uterinae*
- cervix – *canalis cervicis*
  - *ostium histologicum uteri internum*
  - *plicae palmatae*
  - *glandulae cervicales* → closure: *ovula Nabothi* (*glandulae cervicis dilatatae*)
  - *ostium uteri* (= *ostium histologicum uteri externum*) – shape according to number of labors
    - labium anterius + posterius
- *canalis isthmi* = lower uterine segment
  - dilates during delivery

# Uterus – *fixation*

- suspensory ligaments:
  - lig. latum uteri
  - lig. transversum cervicis / cardinale *Mackenrodti*
  - lig. teres uteri
  - lig. pubocervicale et rectouterinum
    - ventrodorsal ligaments – proper clinical terminology:  
*lig. pubovesicalia* → *vesicouterina* → *rectouterina* + *sacrouterina*
- supporting apparatus:
  - m. levator ani
    - m. pubococcygeus → **m. pubovaginalis**
    - mm. perinei (less important)



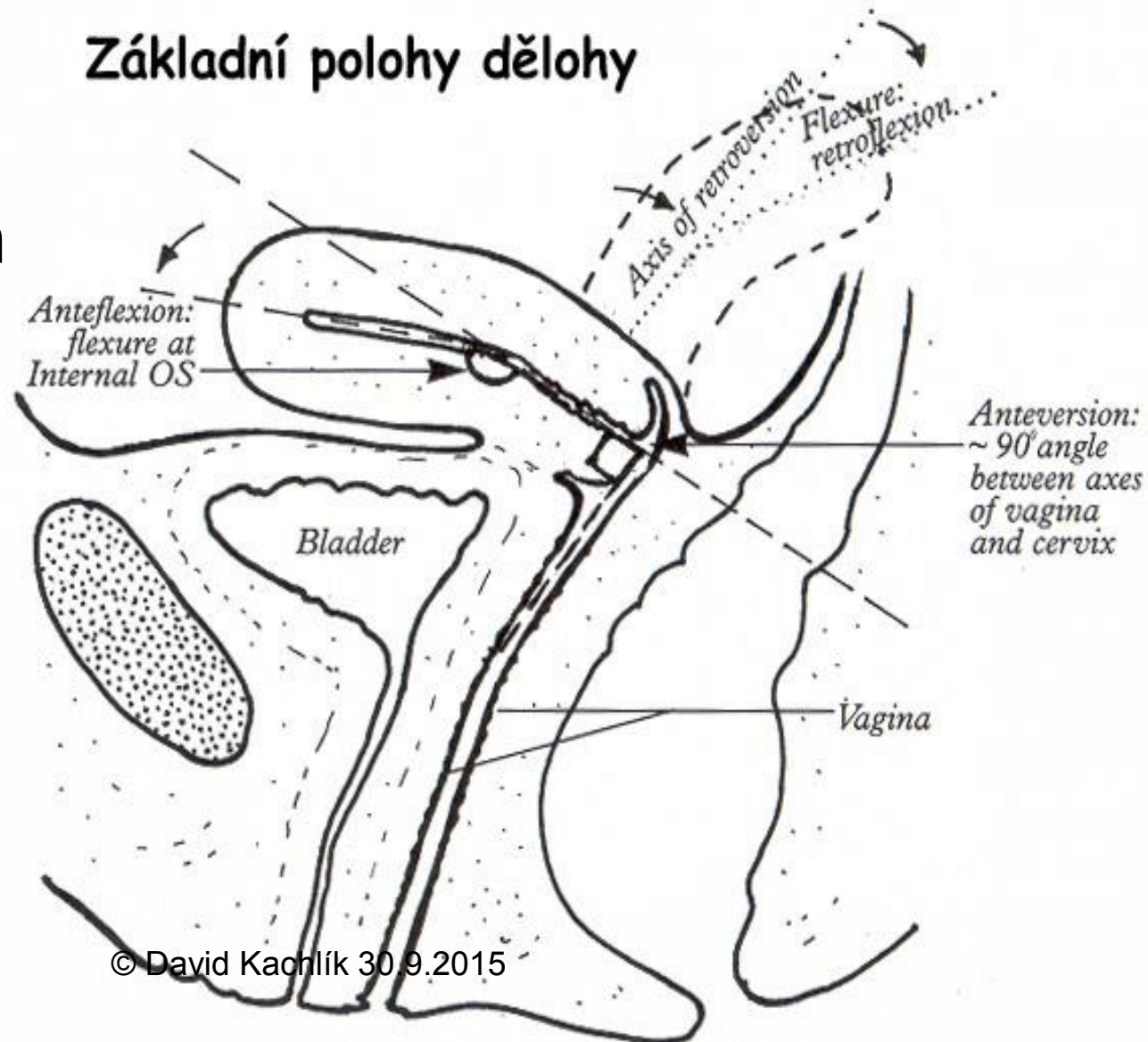
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# Uterus – *position* („AVF“)

- anteflexion
- anteversion
- lateroposition
- dextrotorsion = most common

retroversion  
retroflexion

- during pregnancy, risk of rupture by promontorium

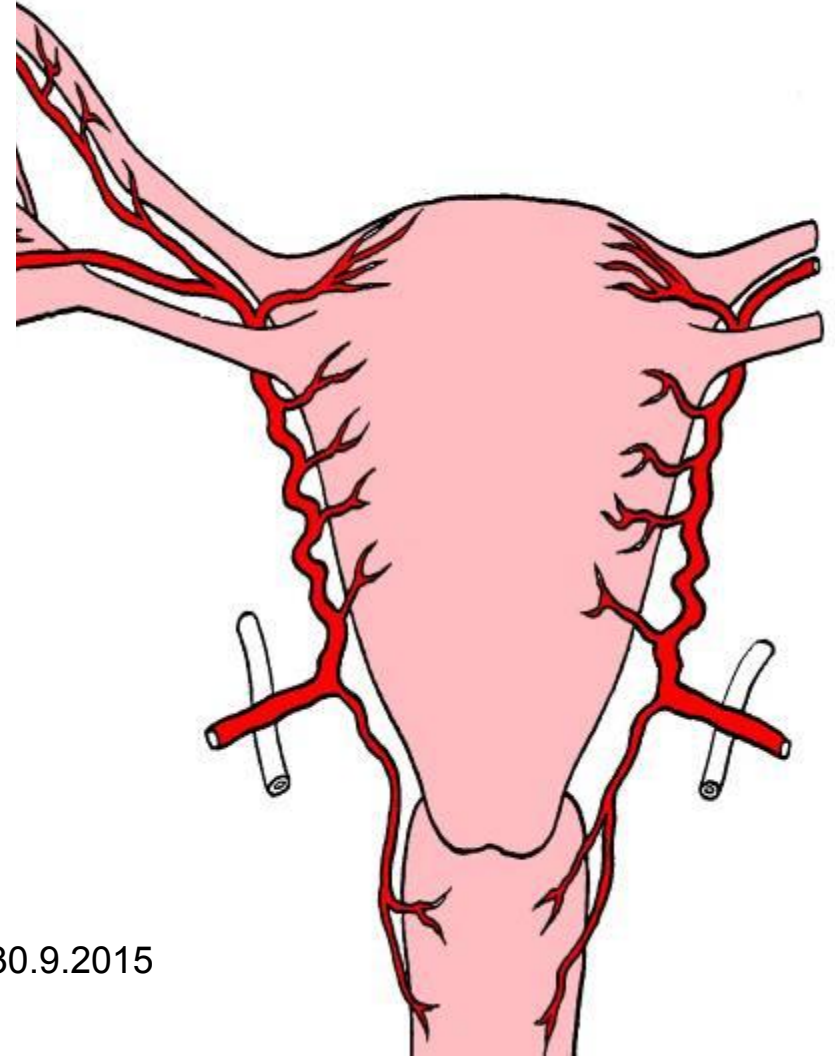


# Uterus – arterial supply

arteries:

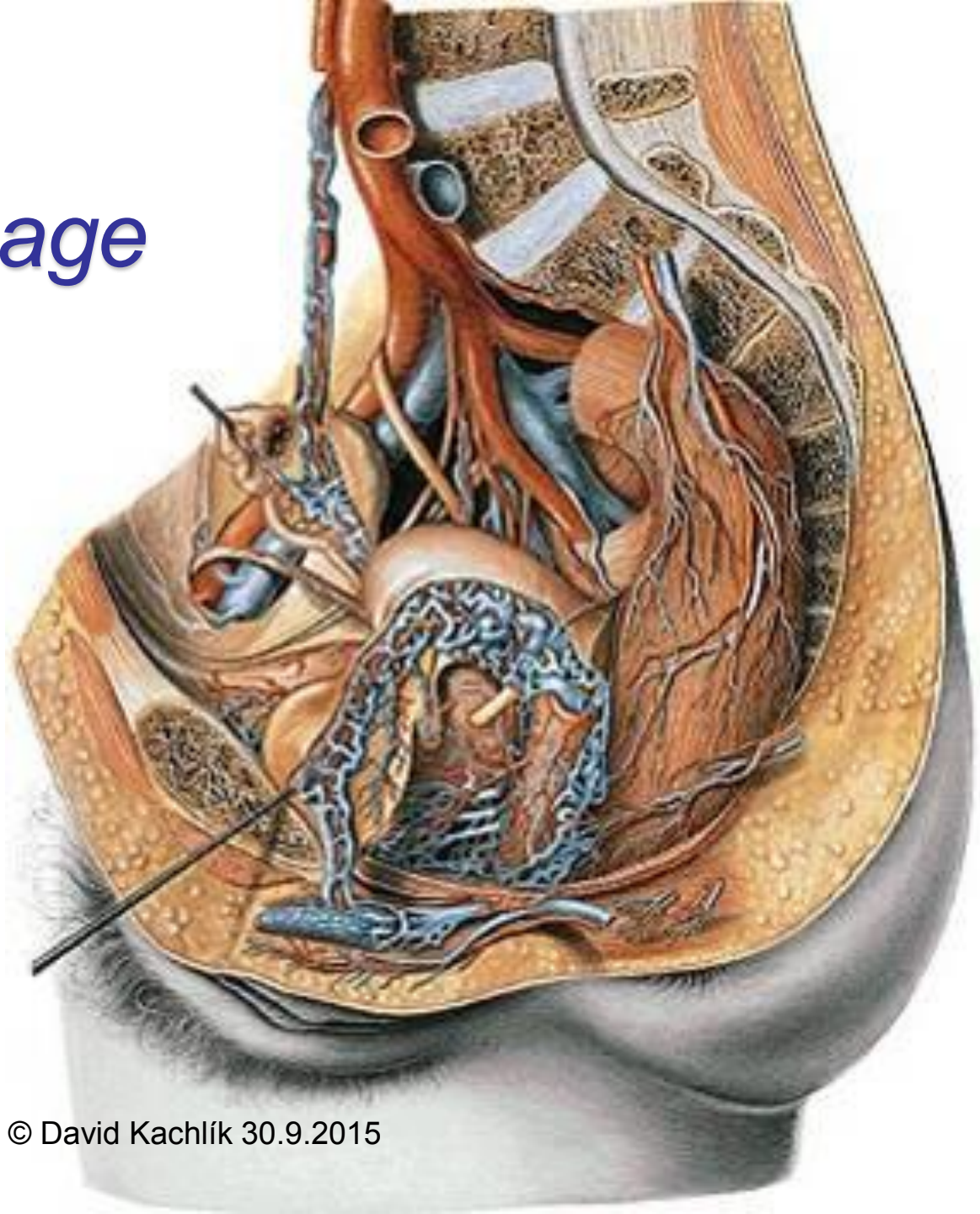
a. iliaca int.  
→ a. uterina

ventrally to ureter  
(„water flows under  
the bridge“)



# Uterus *venous drainage*

plexus  
venosus  
uterovaginalis  
→ vv. uterinae  
→ v. iliaca int.



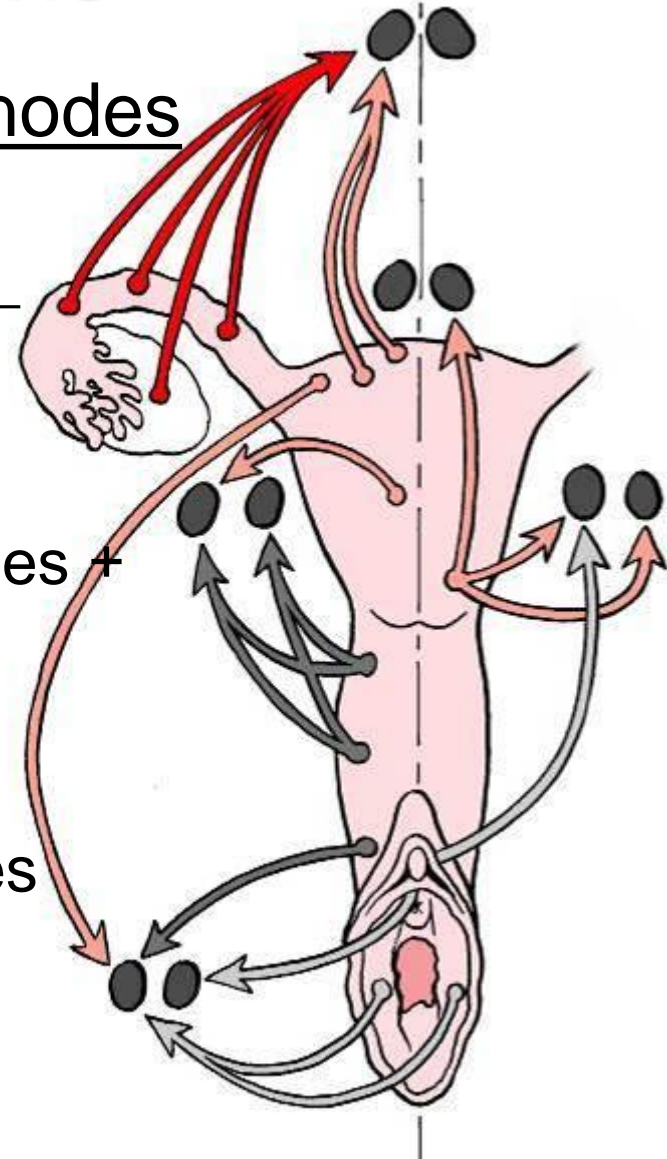
# Uterus – *lymphatic drainage:* 2 classifications

- according to topography of lymph nodes

- n.l.lumbales ← fundus et corpus
- n.l.iliaci interni (externi, communes) ← corpus, isthmus et cervix
- n.l.sacrales ← isthmus, cervix
- (n.l.inguinales superficiales ← margines + cornua)

- according to uterine portion

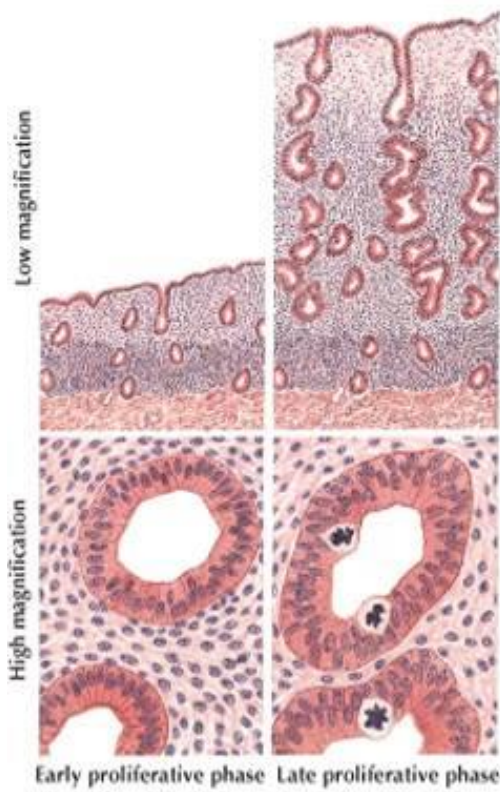
- body → n.l. lumbales, iliaci, (inguinales superficiales)
- cervix → n.l. iliaci, sacrales



# Corpus uteri – *inner structure* 1.

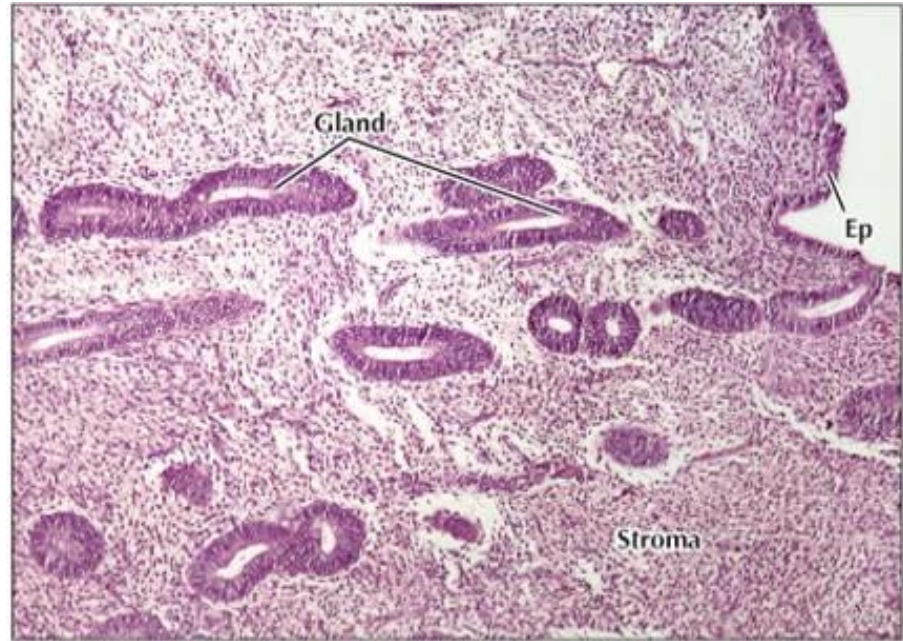
- tunica mucosa – **endometrium**
  - simple columnar epithelium
    - epitheliocytus ciliatus + exocrinocytus uterinus
  - stratum basale
    - DOES NOT undergo changes and is NOT sloughed off during menstruation, ensures regeneration of mucosa
    - more rich in cells and reticular fibers, vessels
  - stratum functionale / spongiosum
    - cyclic changes, periodically sloughed off
  - stratum superficiale / compactum
  - glandulae uterinae – simple tubular glands
  - lamina propria mucosae = stroma endometriale
    - cellula stromalis
    - cellula granularis





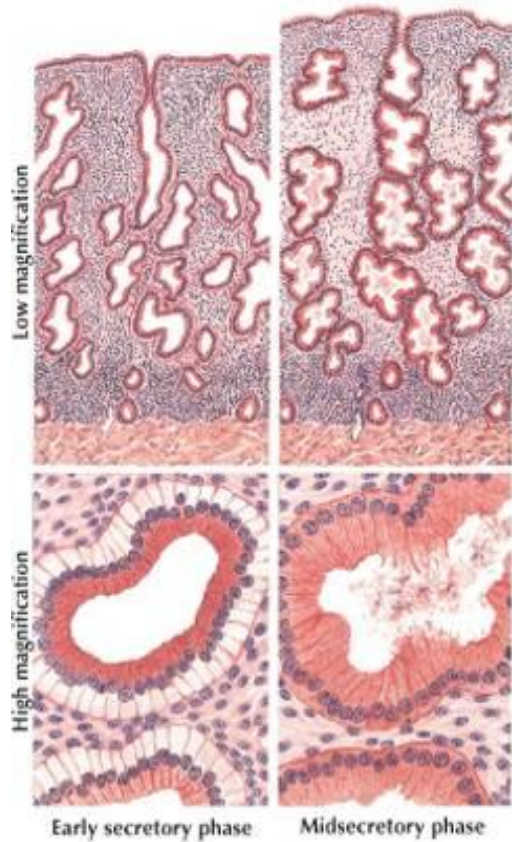
▲ Schematics of the endometrium during early (left) and late (right) follicular phases of the menstrual cycle. In the former, the endometrium is relatively thin, and glands are simple and straight. In the late phase, the thicker endometrium shows marked growth in glands and stroma. Uterine glands appear more convoluted, and mitoses are often seen at higher magnification. This phase is one of maximum regeneration in both epithelium and surrounding stroma.

*F. Netter*



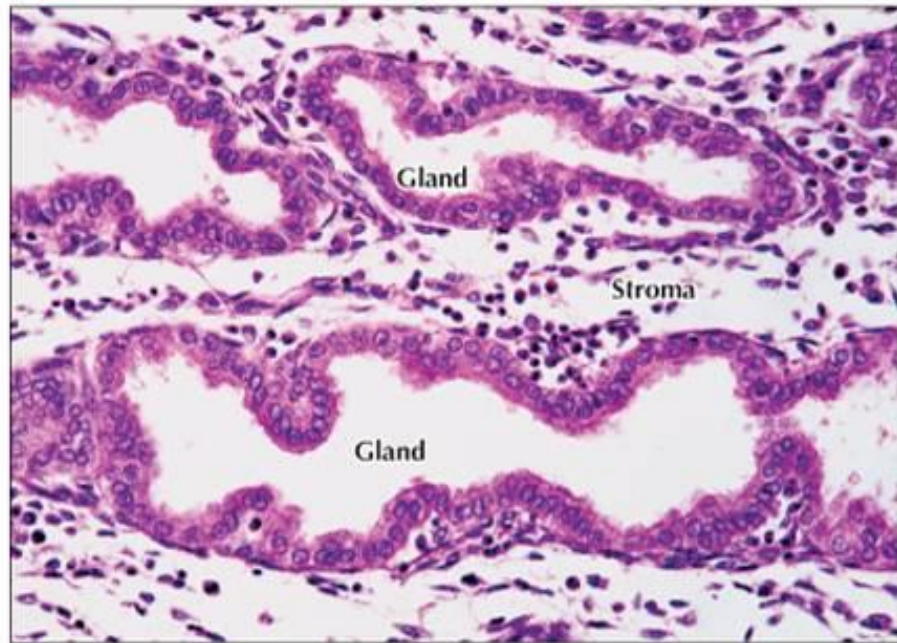
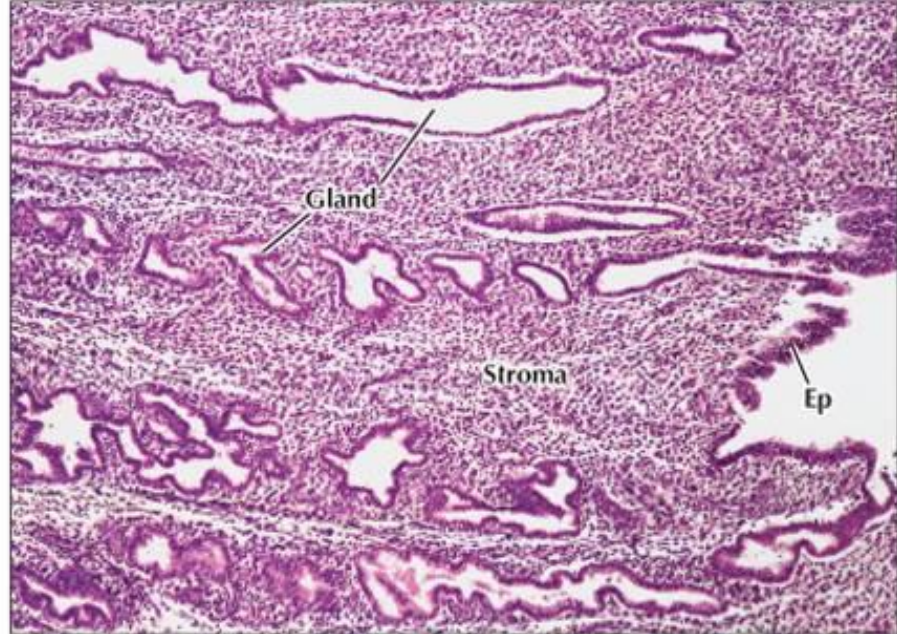
▲ H&E of the endometrium during the early follicular phase at low magnification (Above) and late follicular phase at higher magnification (Below). Uterine glands first appear straight and gradually become more tortuous as they reach the epithelial surface (Ep). Surrounding stroma is highly cellular. Above: 75x; Below: 280x. H&E.

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▲ Schematic of the endometrium during early secretory (left) and midsecretory (right) phases of the menstrual cycle. In the early phase and under the influence of progesterone, endometrial stroma shows less edema. Epithelial cells of the glands have round nuclei, with pale-staining basal cytoplasm due to glycogen deposits. In the later phase, glands have a distinctive saw-toothed appearance, and glandular epithelial cells are tall columnar with apically located glycogen. Secretions form bubbles at luminal margins and are discharged into the glandular lumen.

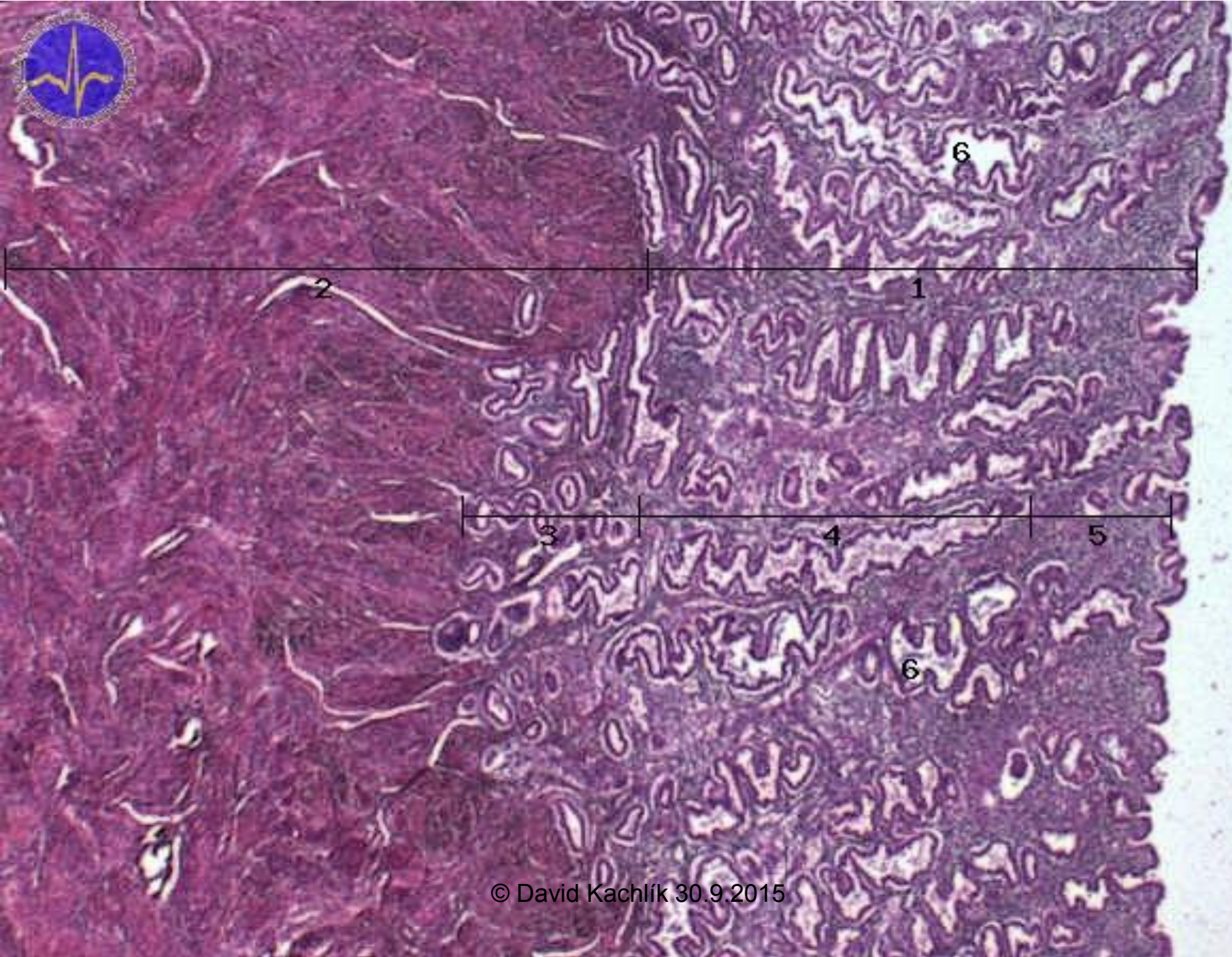
*F. N. ...*

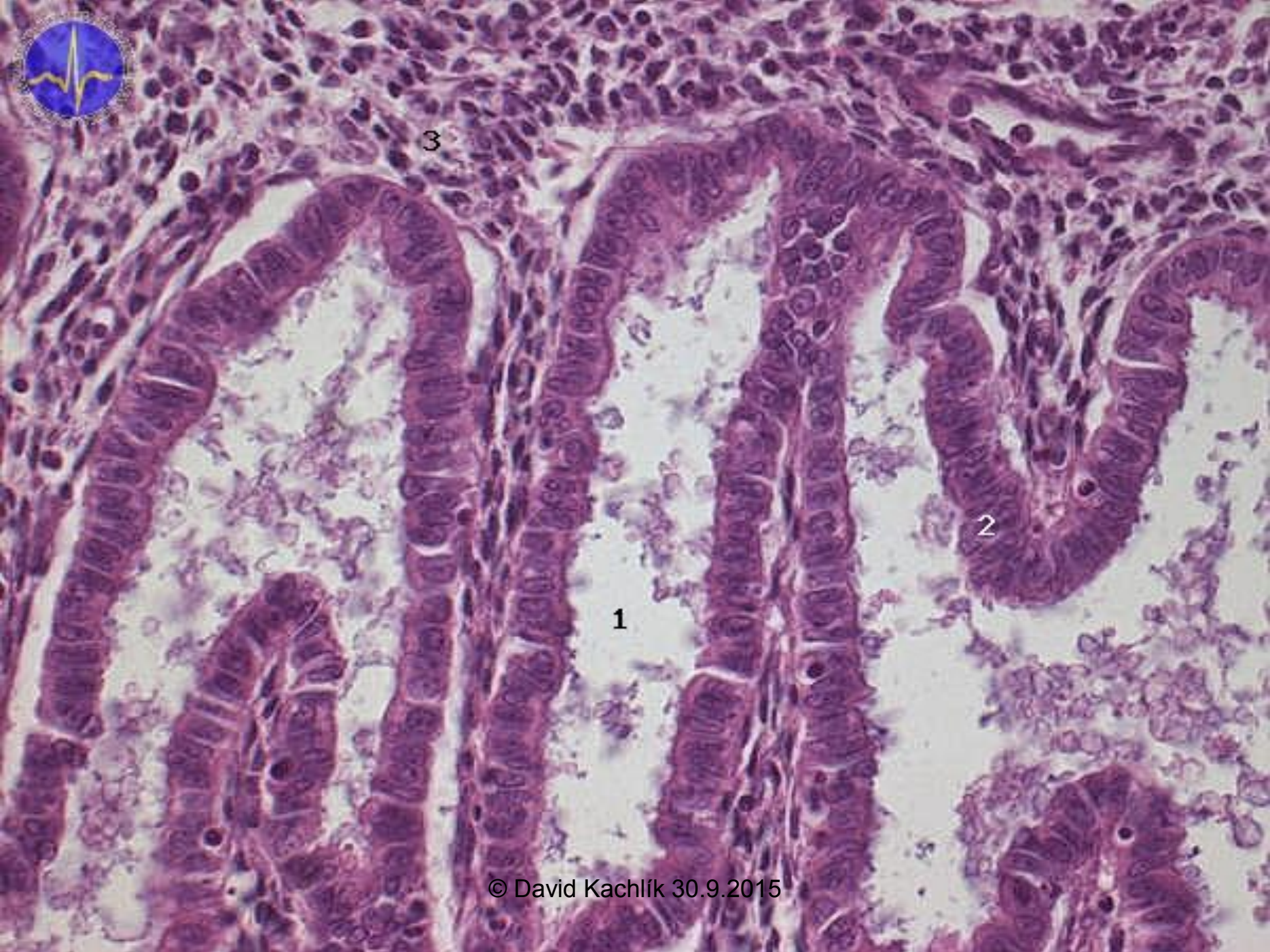


▲ ILMs of the endometrium during the secretory phase of the cycle at low (Above) and higher (Below) magnification. Glandular glands are highly tortuous and have a serrated outline in section. They open onto the epithelial surface (Ep). Surrounding stroma is highly cellular. **Above:** 75×; **Below:** 280×. H&E.

# Corpus uteri – *inner structure* 2.

- tunica muscularis – **myometrium**
  - 15 mm, spirally interwoven densely arranged bundles of connective tissue
  - muscle cells are spindle-shaped about 40-90  $\mu\text{m}$  large (the longest cells in human body)
  - during pregnancy increase in number (hyperplasia) and also in size (hypertrophy)
  - before delivery number of oxytocin receptors is increased (200 times)
  - 3 layers (stratum submucosum, vasculosum, supravasculosum)
- tunica serosa = peritoneum – **perimetrium**
  - tela subserosa (contains stratum musculorum subserosum = 4th muscular layer)
- tunica adventitia – **parametrium**
  - loose collagen connective tissue, vessels + suspensory ligaments

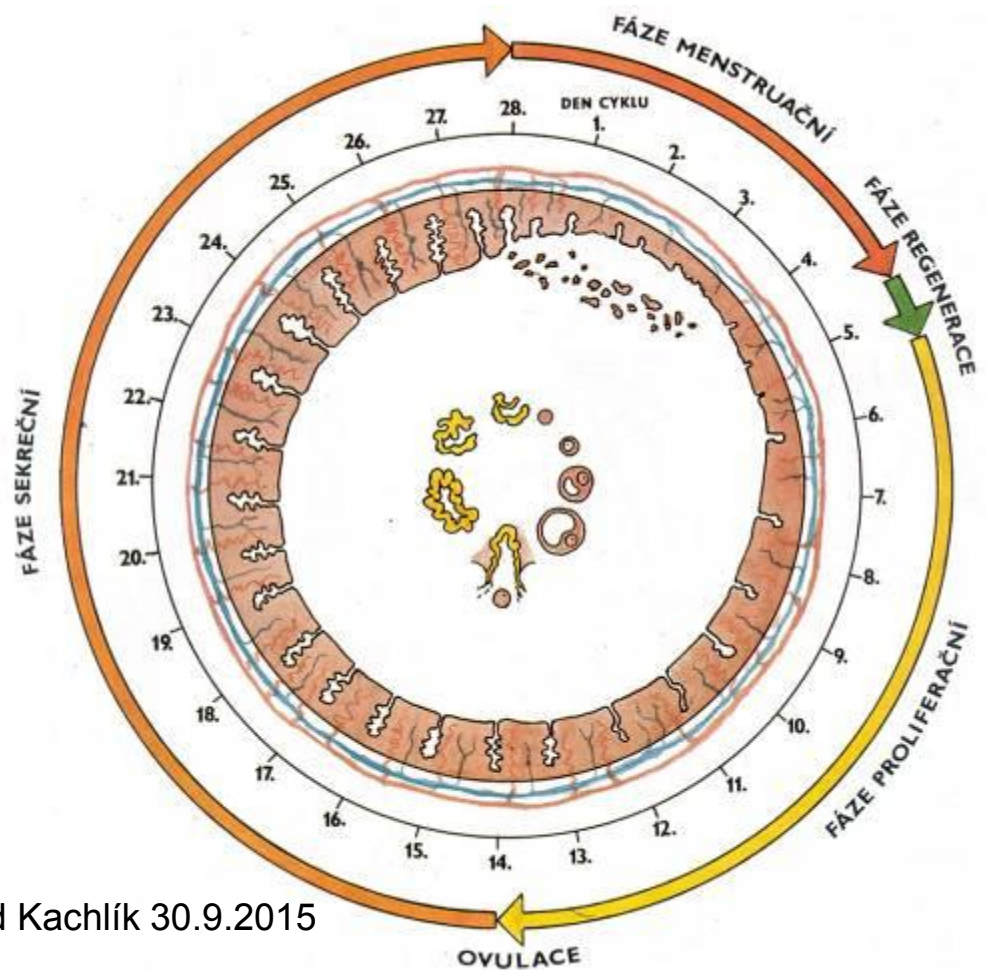




# Menstruation = *Menstruatio*

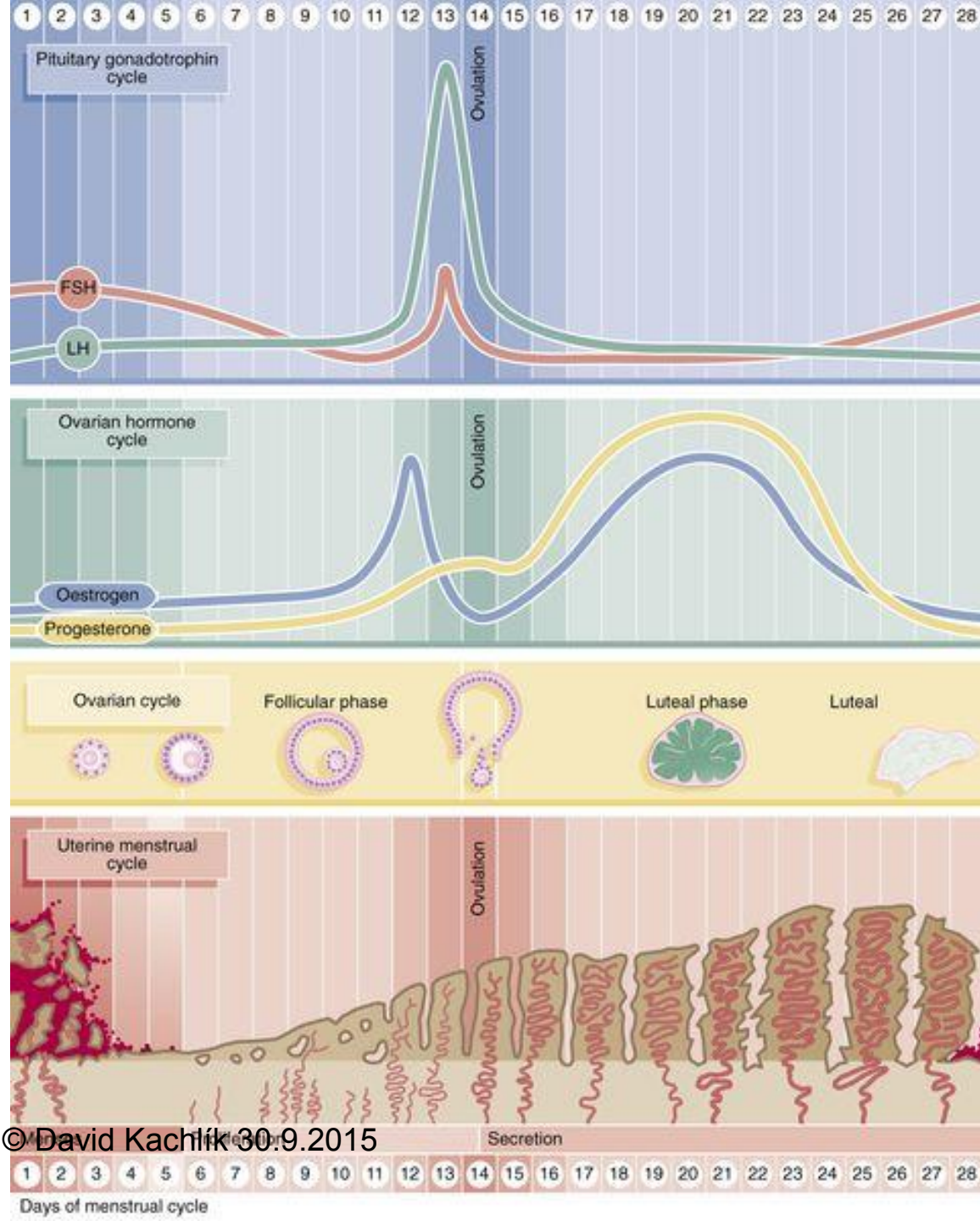
## menstrual cycle

- menstrual phase – 1st-4<sup>th</sup> day
- proliferative phase – 5<sup>th</sup>-14<sup>th</sup> day
- secretory phase – 15<sup>th</sup>-28<sup>th</sup> day
- ischemic phase – 28<sup>th</sup> day



- menarché (10<sup>th</sup>-13<sup>th</sup> year of age)

- menopause (about 50<sup>th</sup> year of age)



# Menstral phase

## *Phasis menstrualis / desquamativa*

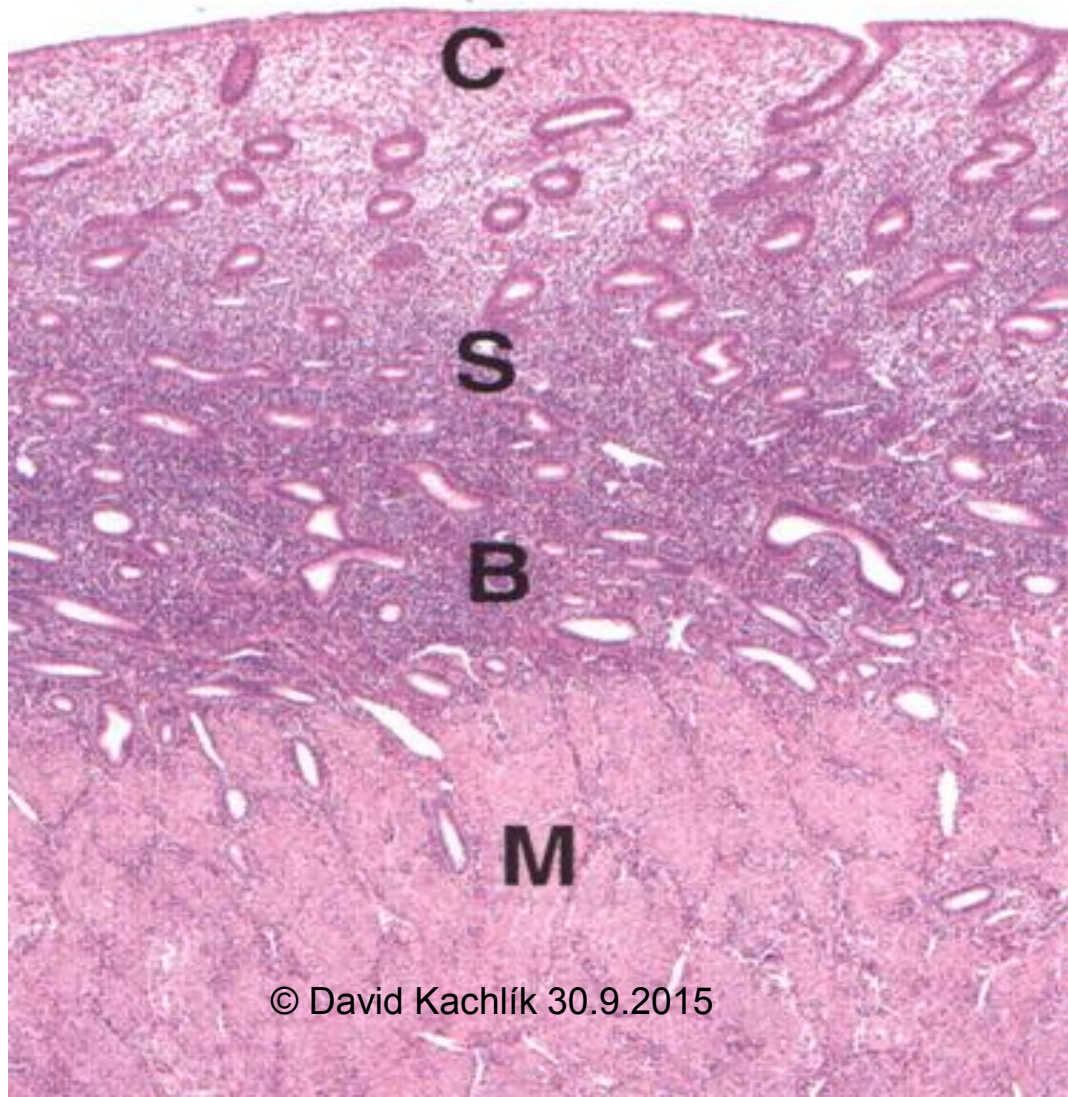
- stratum functionale et superficiale tunicae mucosae are sloughed off
- stratum basale remains
- re-epithelialization of nuded surface
  - finished 5<sup>th</sup> day = phase of regeneration
- mucosa 0.5-1 mm thick



# Proliferative phase

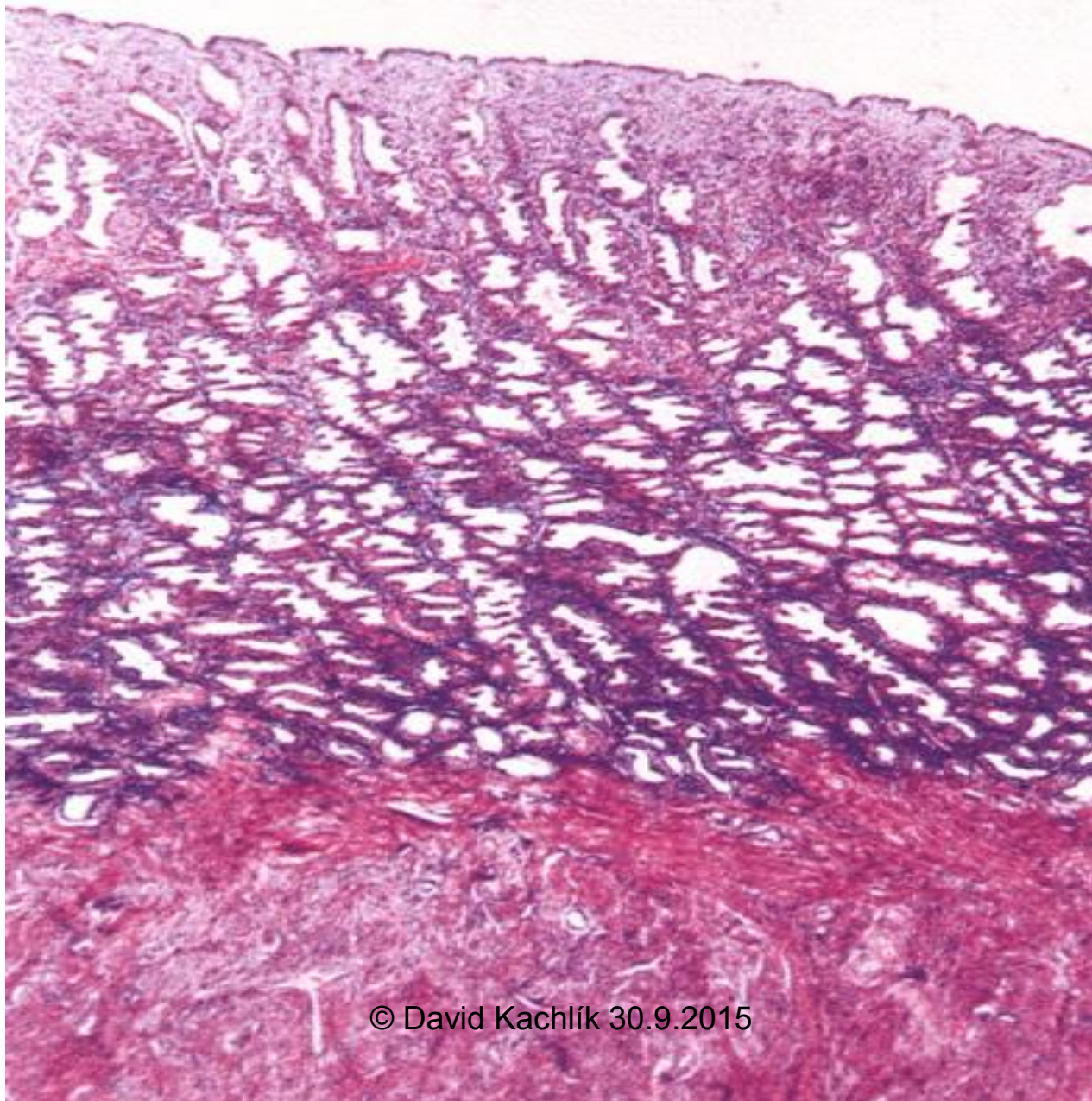
## *Phasis proliferativa / follicularis*

- under influence of estrogens
- mitotic activity → hyperplasia (↑ count) of stratum functionale
- elongation of glands, they are narrow, without secretion, by the end of phase they begin to coil
- cytoplasm of epithelial cell is rich in gER
- mucosa 3 mm thick
- increased level of LH → **ovulation** (14<sup>th</sup> day)



# Secretory phase (*Phasis secretoria*)

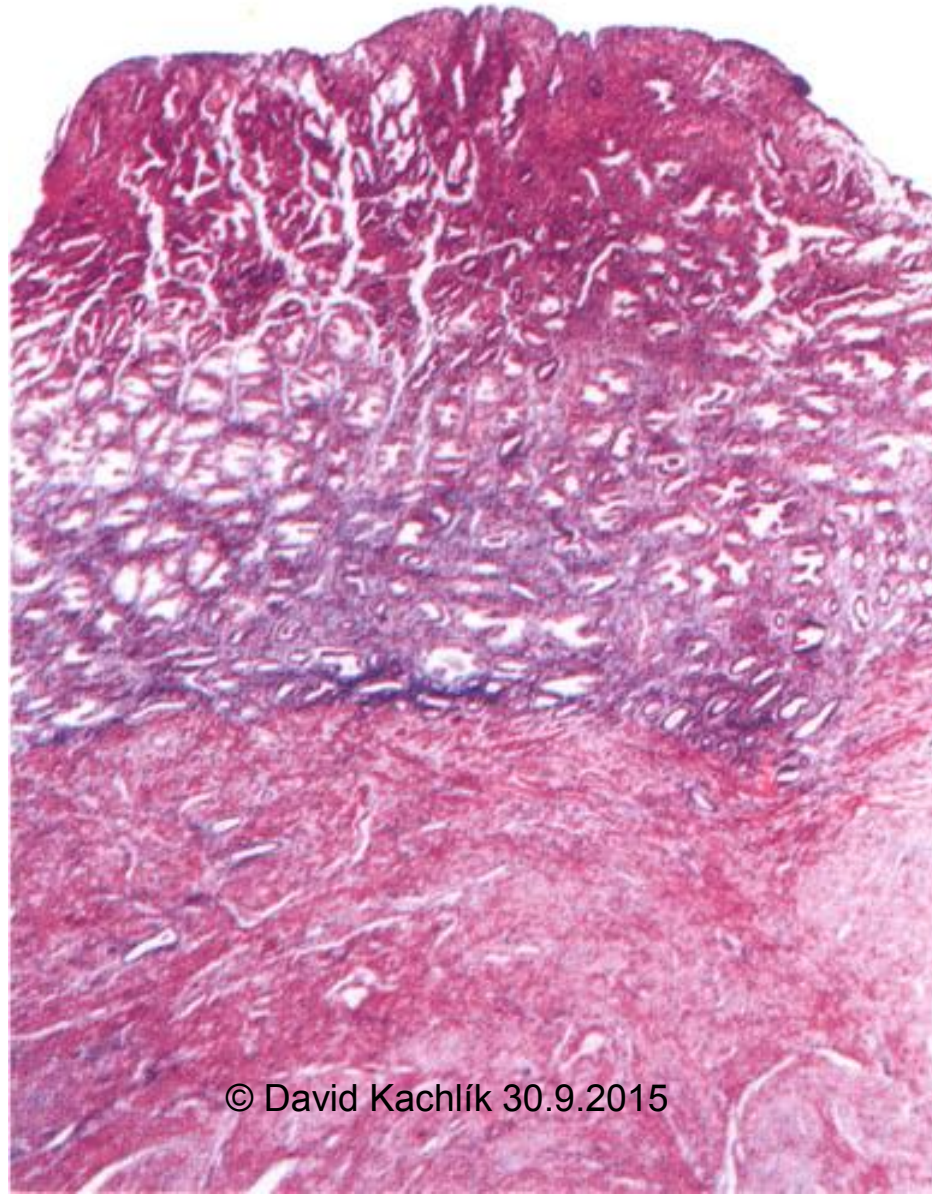
- influence of hormones from corpus luteum (progesteron)
- stratum functionale – hypertrophy (↑ size)
  - glands are coiling (except basal and apical ends)
    - stratum spongiosum – coiled
    - stratum compactum – straight
    - secretion contains mucine, glycogen and lipids
  - epithelial cells contain mucine and glycogen (first in basal portion, then in apical)
- arterioles elongate and coil
- mucosa 6-7 mm thick
- decidual reaction
  - stromal cells enlarge and fill with glycogen and lipids (*cellulae predeciduales*)
  - later during pregnancy they exhibit mitotic activity (*cellulae deciduales*)



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# Ischemic phase (*Phasis ischemica*)

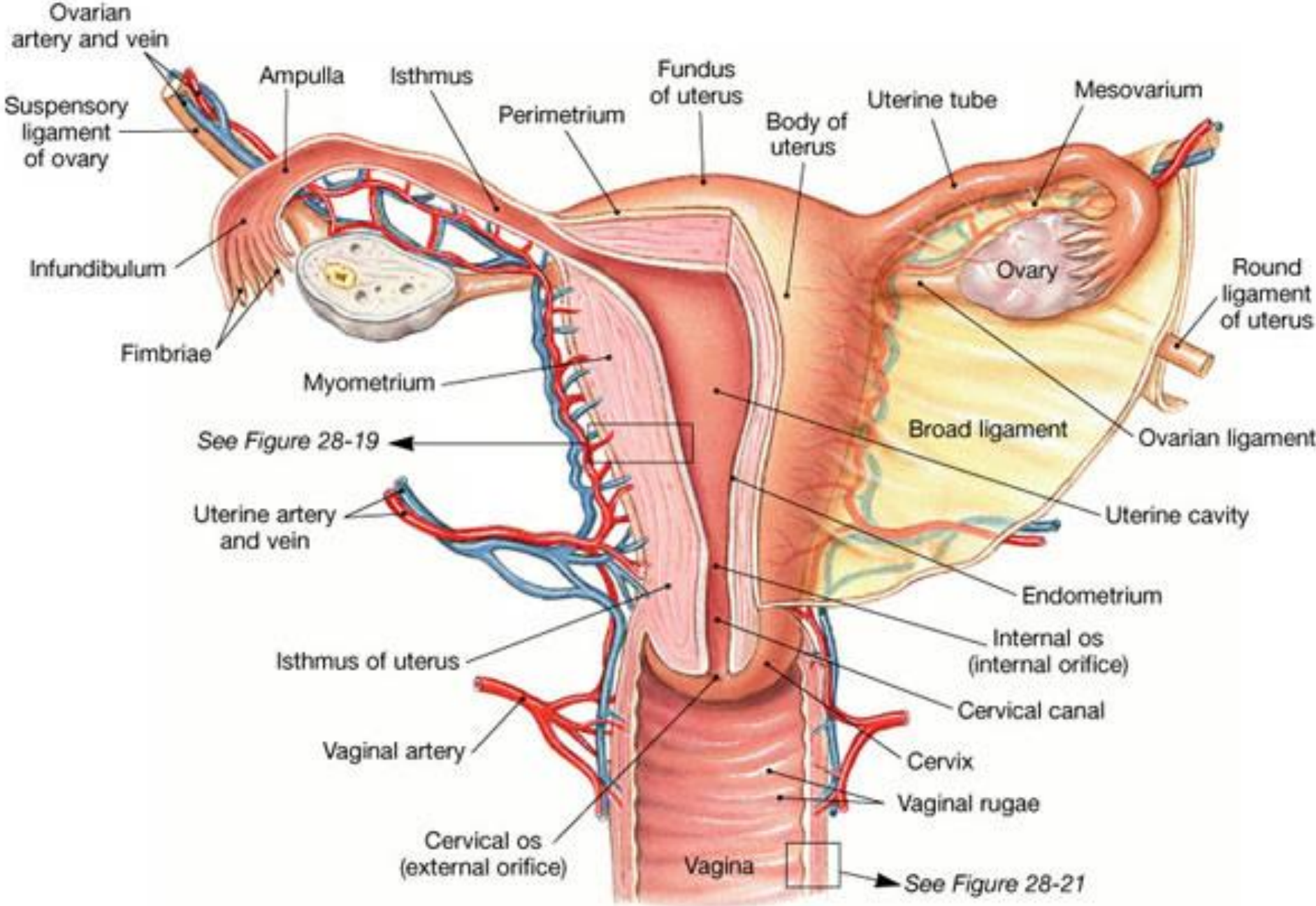
- 1 day
- due to decreased level of progesteron
- constriction of spiral arterioles → ischemia of stratum functionale et superficiale → necrosis
- migration of leukocytes → degenerative processes
- menstrual blood
  - mix of arterial and venous blood
  - enzymes from mucosa → incoagulable
- contraction of myometrium and vessels → stop the bleeding



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# Uterine isthmus = *Isthmus uteri*

- 5-9 mm
- structure similar to uterine body
  - myometrium contains less vessels → surgical approach to Caesarean section
  - lower endometrium, does not undergo cyclic changes
  - boundary of mucosa between body and cervix (*ostium histologicum uteri internum*)



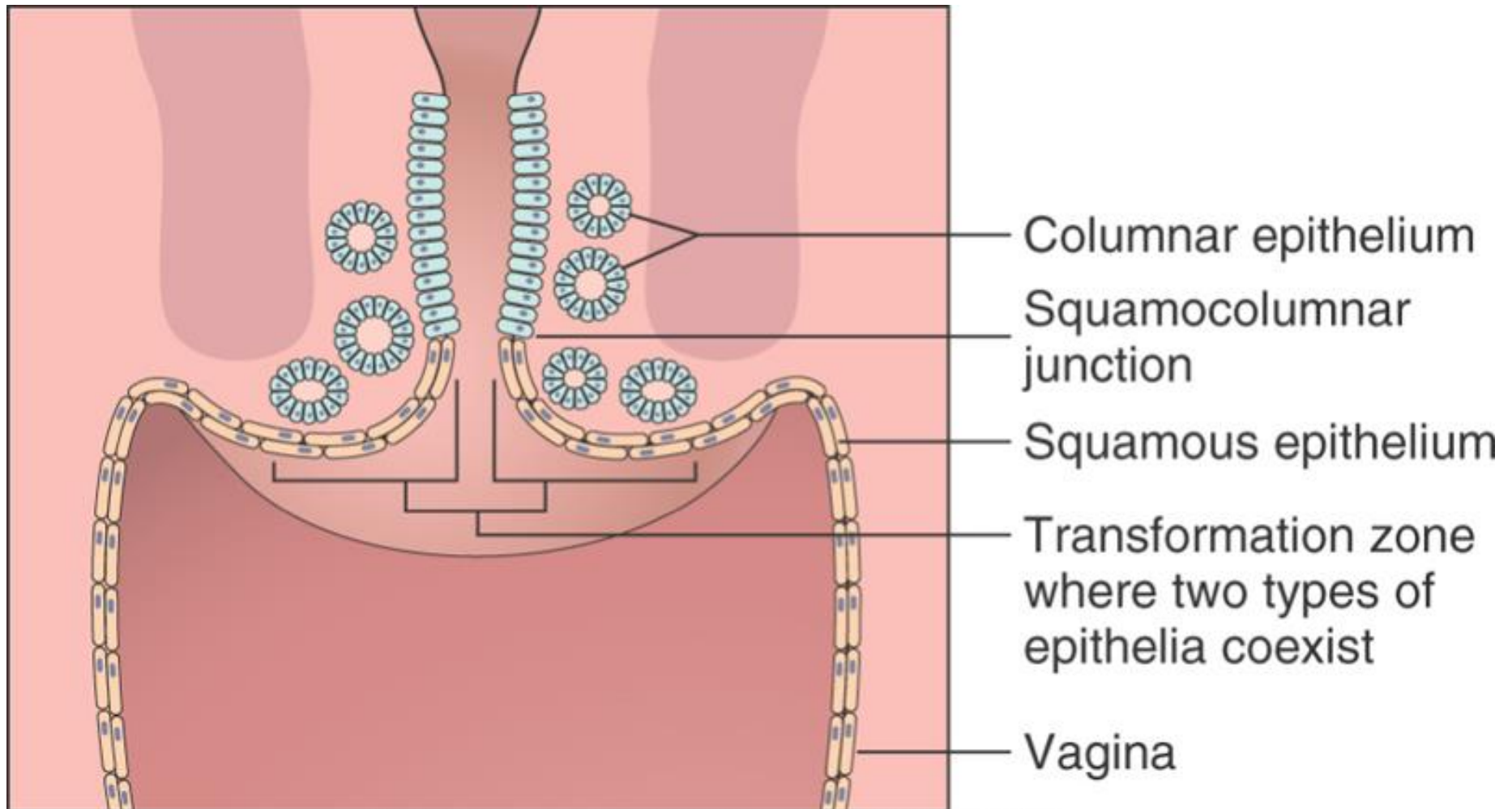
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(c) Posterior view



# Uterine cervix = *Cervix uteri* 1.

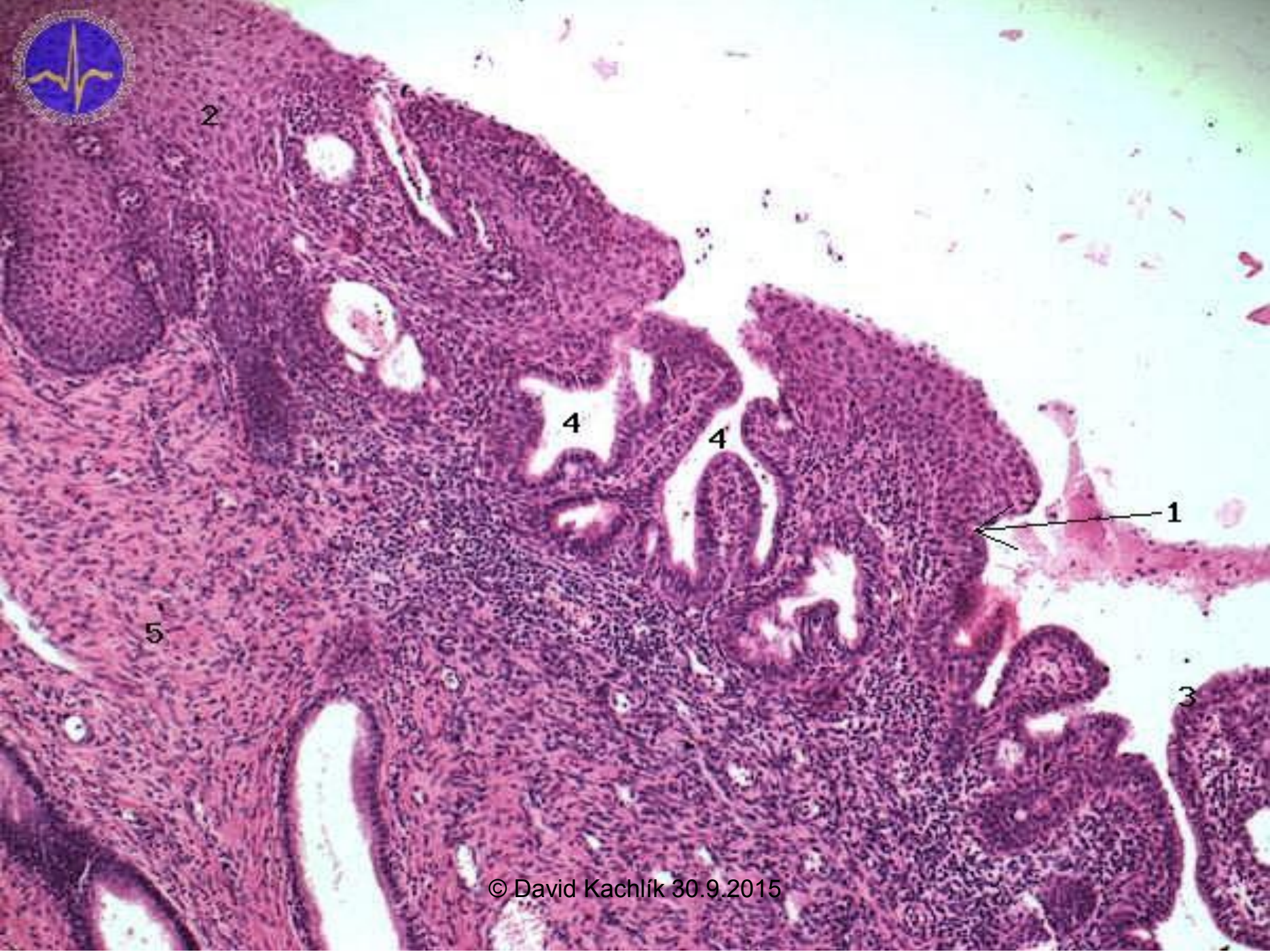
- portio supravaginalis cervicis
  - upper part surrounded by fibrous tissue of parametrium
- portio vaginalis cervicis = **ectocervix**
  - lower part protrudes into vagina
- canalis cervicis
  - plicae palmatae
  - crypts – with opening of tubular glandulae cervicales
    - alkaline secretion, various density depending on phase of cycle
  - tunica mucosa endocervicalis
    - simple columnar epithelium
    - mucous cells (*mucocyti*), less of ciliated cells (*epithelocyti ciliati*)
- mucous plug (*obturamentum cervicale*)



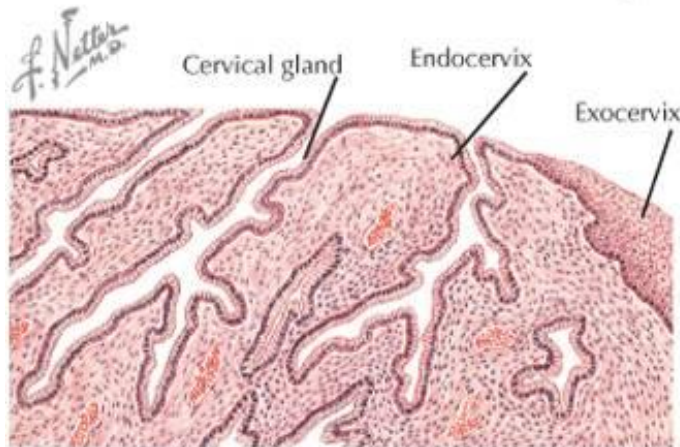
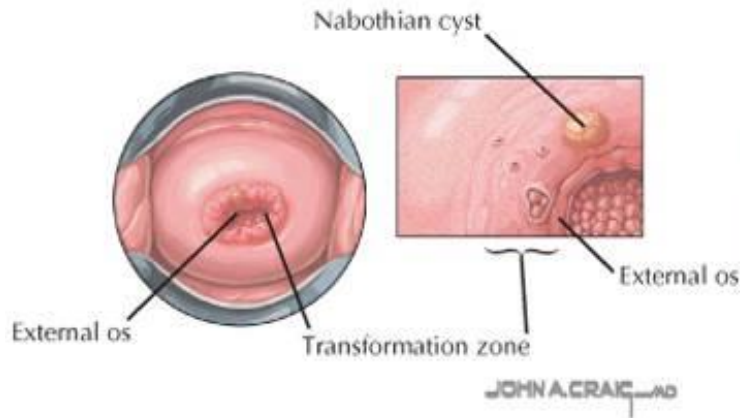
Kumar et al: Robbins & Cotran Pathologic Basis of Disease, 8th Edition.  
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# Uterine cervix = *Cervix uteri* 2.

- tunica mucosa exocervicalis (vaginal surface of cervix)
  - non-keratinized stratified squamous epithelium (similar to vaginal epithelium)
  - transition in area of ostium uteri (external orifice of uterus)
  - borderline with columnar epithelium lies in endocervix – is not visible
- ectropium = endocervical epithelium extends to the vagina (after labour)
- ectopia = epithelial metaplasia = precancerosis (columnar epithelium is replaced by stratified squamous – transformation zone) → conization
- HPV

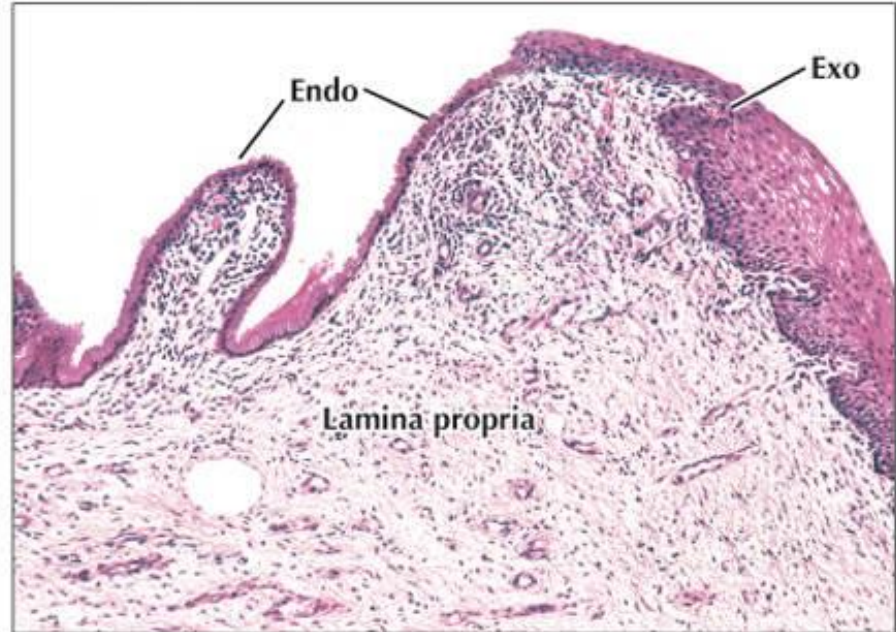


▼ Low- and high-power colposcopic views of the normal transformation zone.

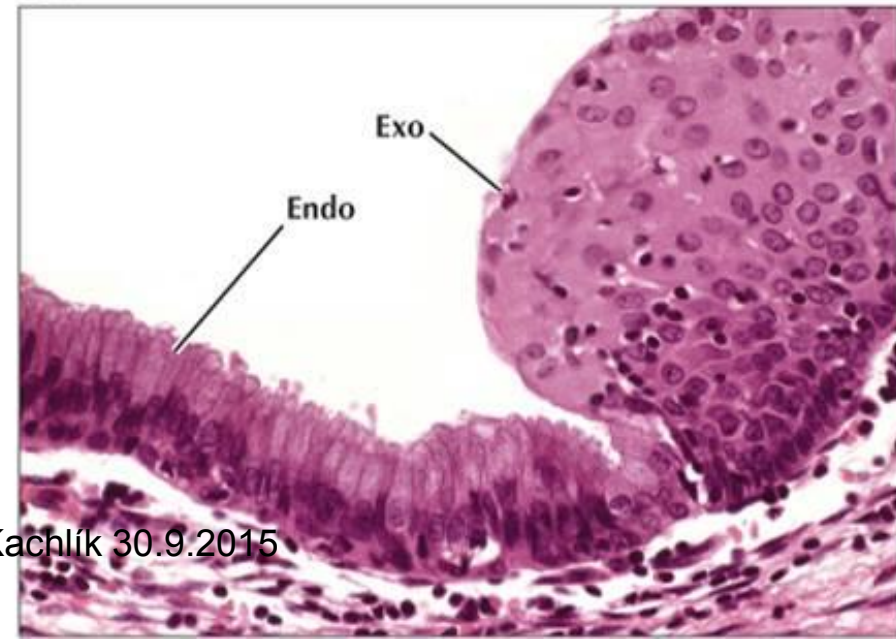


▲ Schematic of the cervical squamocolumnar junction.

► Higher magnification LM of the cervical squamocolumnar junction. The endocervix (**Endo**) is lined by simple columnar epithelium with tall mucus-secreting cells. The epithelium abruptly changes to a nonkeratinized stratified squamous type in the exocervix (**Exo**). 290×. H&E.



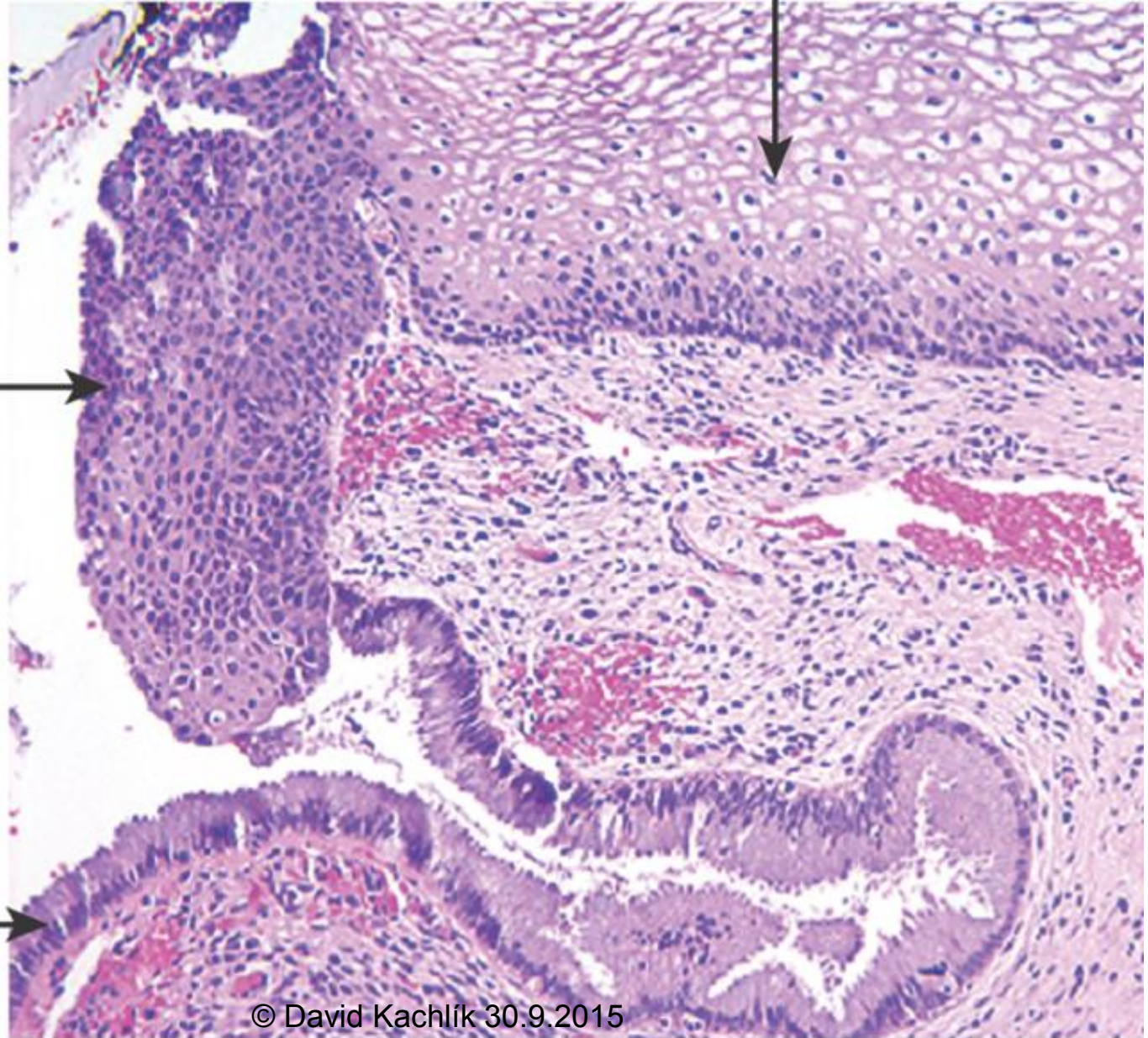
▲ Low-magnification LM of the mucosa of the uterine cervix. The simple epithelium of the endocervix (**Endo**) is highly folded and continuous with stratified epithelium of the exocervix (**Exo**). Underlying lamina propria is richly cellular. 96×. H&E.



Mature squamous cells

Immature  
squamous  
cells

Columnar  
glandular  
cells



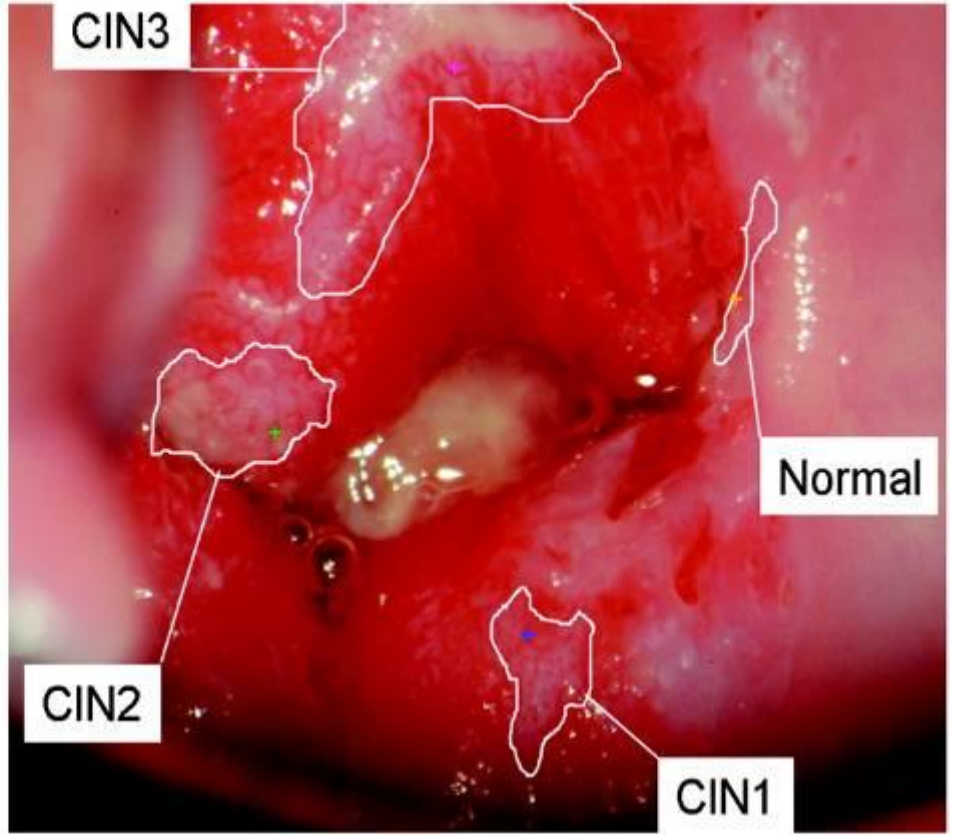
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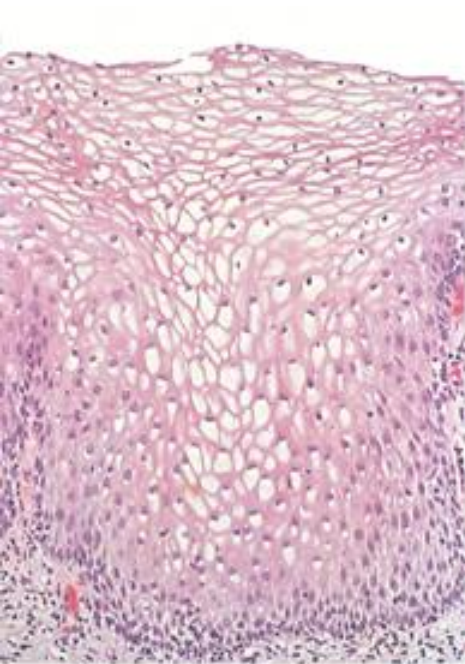
# Cervical metaplasia

A

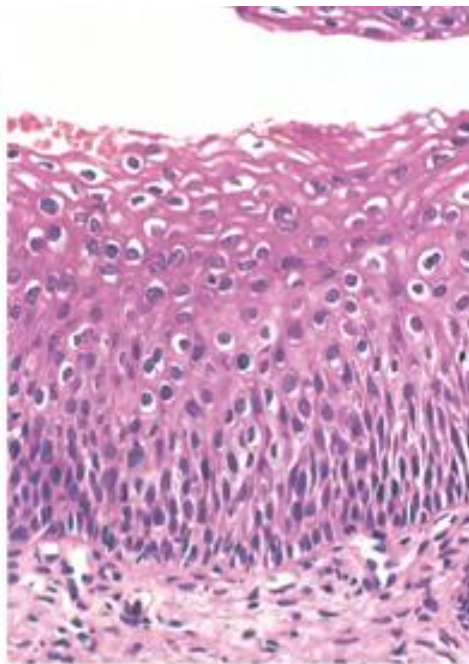


B

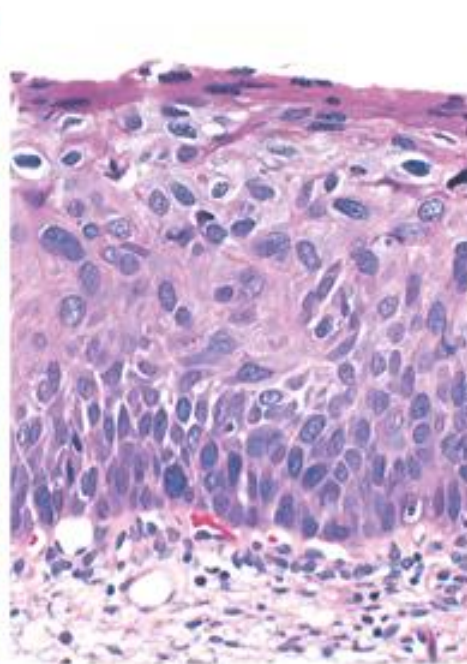




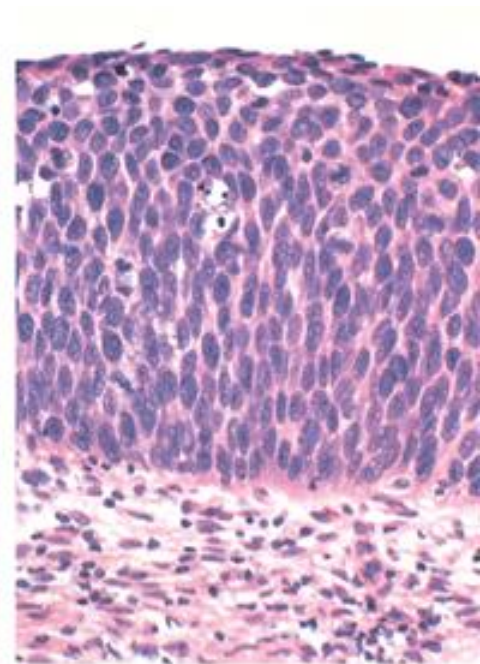
Normal



CIN I



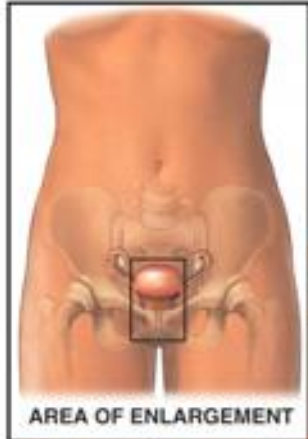
CIN II



CIN III

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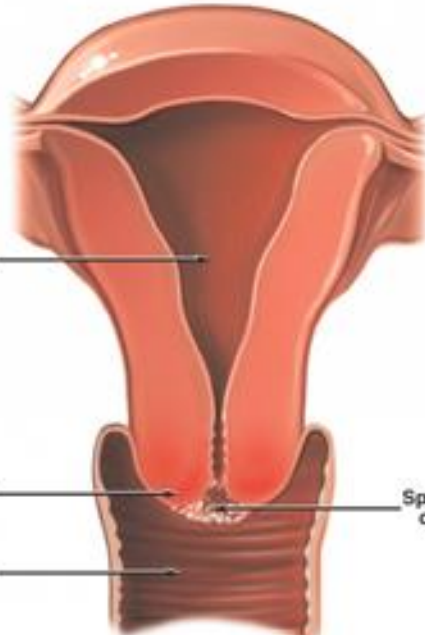




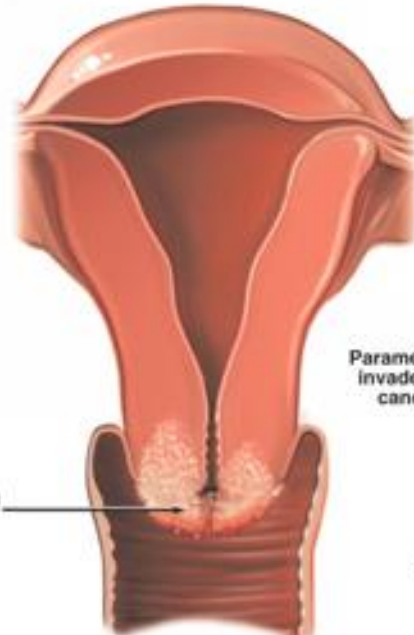
AREA OF ENLARGEMENT



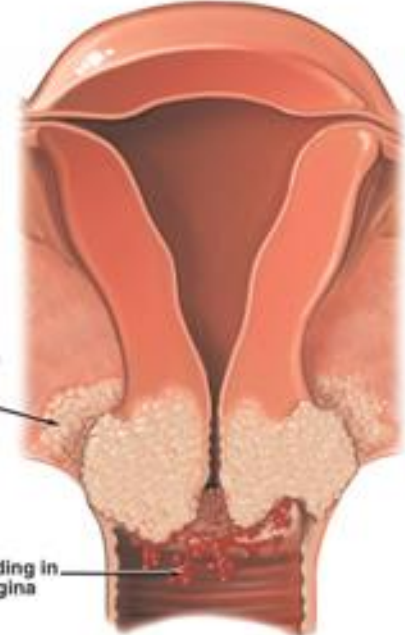
Normal cervix and vagina (cut-away view)



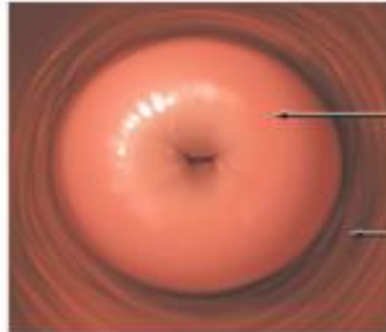
Early stage IB cancer of cervix



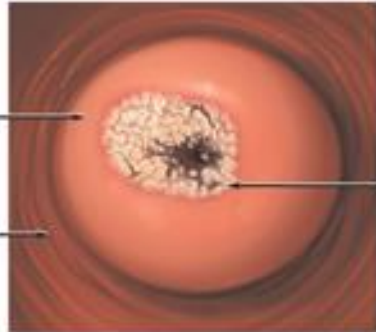
Late stage IB cervical cancer



Stage IIB: The cancer spreads outside cervix to pelvic tissue



Normal cervix (speculum view)



Early stage IB cervical cancer



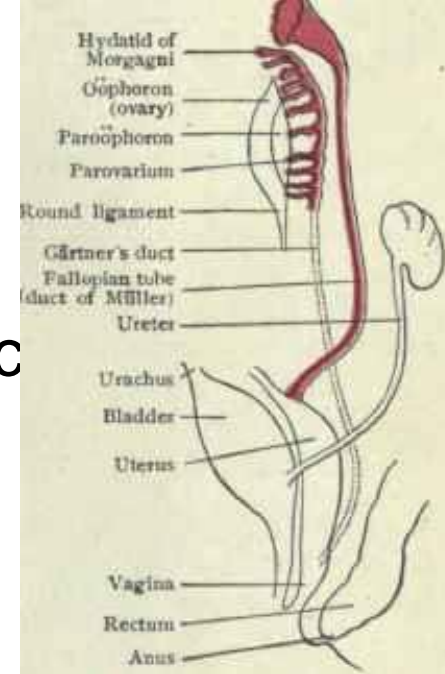
Late stage IB: cervical cancer is spreading to cervix



Stage IIB cervical cancer

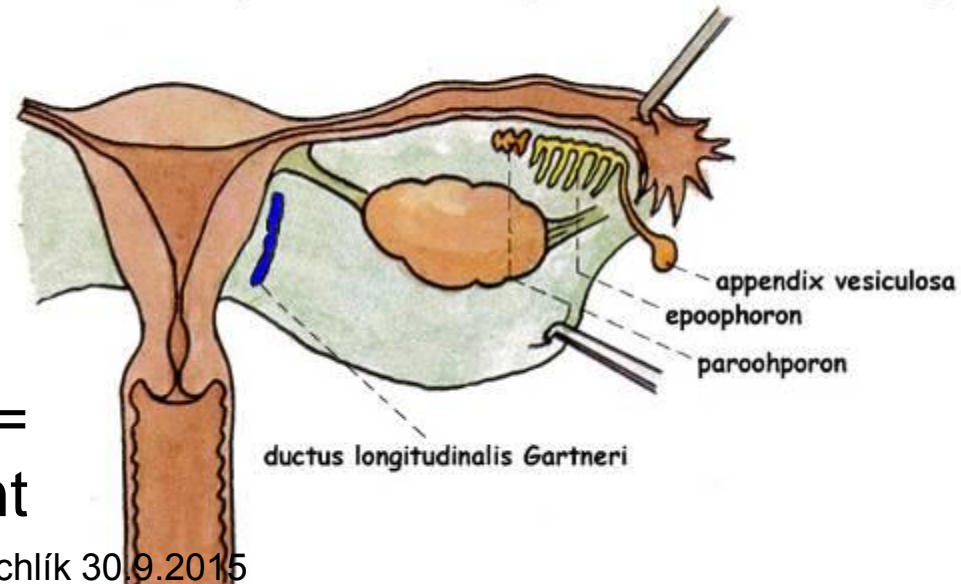
# Developmental remnants in female

- **epoophoron** *Rosenmülleri* – in mesosalpinx
  - ductuli transversi (remnants of mesonephric tubules)
  - ductus longitudinalis Gartneri (remnant of Wolffian duct near the uterine margin in lig. latum uteri)



- **paroöphoron** *Kobelti* (remnant of mesonephric tubules)
  - in mesosalpinx closer to uterus

## Rudimenty ženského pohlavního ústrojí



- **appendices vesiculosae** (= *hydatis Morgagni*) – remnant of Wolffian duct

# Clinical points

- tumors
  - benign – leiomyom
  - malignant – adenocarcinoma
- endometriosis
- amenorrhea
- dysmenorrhoea
- menorhagia, menometrorrhagia

# Vagina = *Kolpos*

- 10 cm long muscular tube
- fornix (posterior, anterior, lateralis)
- paries (anterior, posterior)
- ostium vaginae
  - hymen → defloration → carunculae hymenales
- canalis vaginae
  - rugae vaginales
  - columnae rugarum (anterior, posterior)
  - carina urethralis
  - area trigonalis © David Kadnik 30.9.2015

# Vagina – *relations and syntopy*

- septum urethrovaginale et rectovaginale *Denonvilliersi*
- excavatio rectouterina *Douglasi*
  - peritoneum attaches the dorsal vaginal vault
  - palpation, puncture, colposcopy
- m. pubovaginalis → promontorium of Thomas

# Vagina – supply

- arteries: **a. iliaca interna**
  - a. vaginalis (sometimes missing)
  - a. uterina → r. vaginalis
  - a. rectalis media → r. vaginalis
  - a. pudenda int. → r. vaginalis
- veins: **plexus venosus uterovaginalis** → v. pudenda int., v. uterina → v. iliaca int.
- lymph: **n.l. iliaci int.+ ext.**
  - n.l. inguinales superficiales (caudally to hymen)

# Vagina – *structure*

- tunica mucosa: fold and columns
  - epithelium: non-keratinized stratified squamous
  - glycogen → *Lactobacillus acidophilus* → lactate → acid pH (4-5)
  - **no** glands (surface lubricated from cervical glands and by transudation)
- tunica muscularis: smooth muscle tissue
  - inner – circular
  - outer – longitudinal
- tunica adventitia
  - paracolpium

# Vagina – *epithelium*

- stratum basale – proliferation
- stratum parabasale – begin of differentiation, larger cells
- stratum intermedium – glycogen, differentiation, flattened cells
- stratum superficiale – ↑ glycogen, ↑ differentiation, flattened cells
  
- dendritic cells
- cyclic changes
  - proliferative phase – cells containing acidic cytoplasm
  - secretory phase – cells containing basophilic cytoplasm
- *vaginal (exfoliative) cytology*



# Vagina - HE



# Pochva - *PAS+HE*

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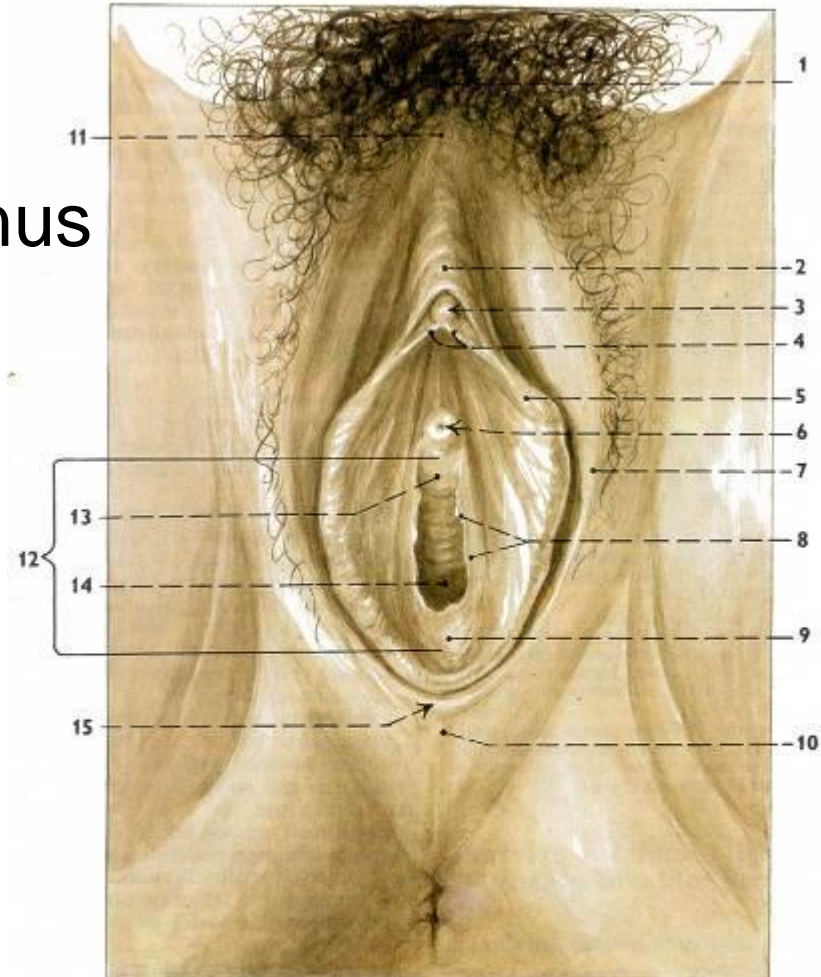
# Vagina – *interesting things*

- colposcopy
- culdoscopy
- exfoliative vaginal cytology
- MOP I (pathologic conditions MOPII-VII)
- episiotomy
- G-point (Grafenberg) does not exist

# Organa genitalia feminina externa (pudendum femininum, vulva)

## vulva

- mons pubis = tubercle of Venus
- labia pudendi
- vestibulum vaginae
  - bulbus vestibuli
  - glandulae vestibulares
- clitoris
- urethra feminina



253. ORGANA GENITALIA FEMININA EXTERNA (poloschematically)

- |                              |                                    |
|------------------------------|------------------------------------|
| 1 / mons pubis               | 9 / fossa vestibuli vaginae        |
| 2 / praeputium clitoridis    | 10 / commissura labiorum posterior |
| 3 / glans clitoridis         | 11 / commissura labiorum anterior  |
| 4 / frenulum clitoridis      | 12 / vestibulum vaginae            |
| 5 / labium minus pudendi     | 13 / carina urethralis vaginae     |
| 6 / ostium urethrae externum | 14 / ostium vaginae                |
| 7 / labium majus pudendi     | 15 / frenulum labiorum pudendi     |
| 8 / hymen                    |                                    |

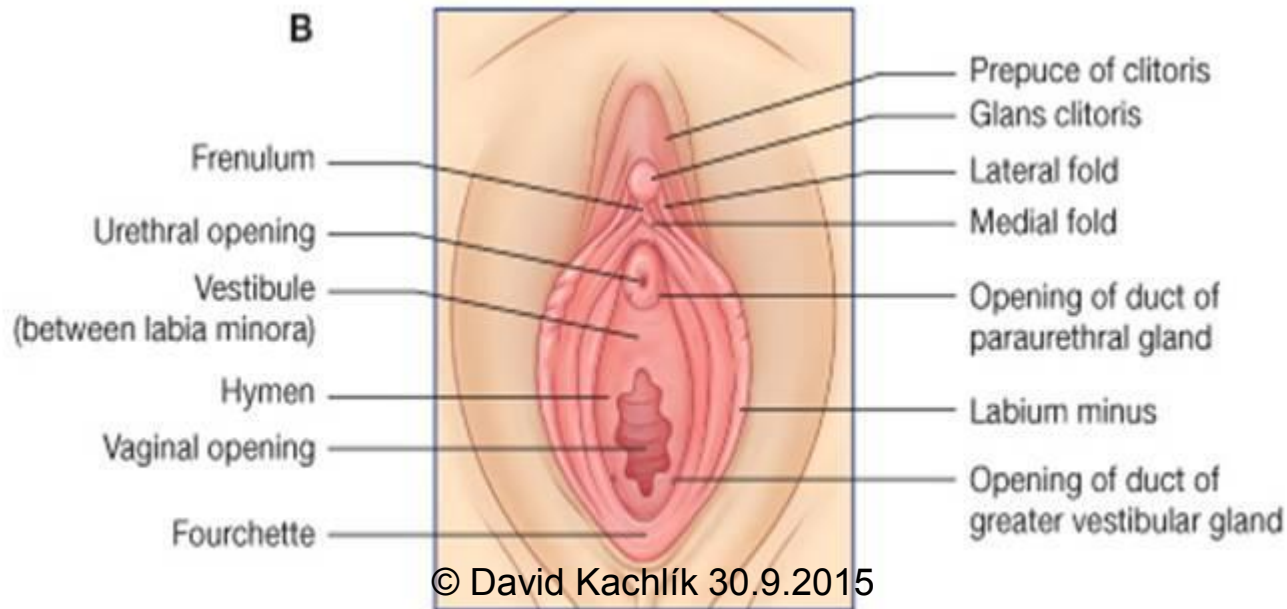
# Labia = Labia pudendi

- labia majora
  - collagen connective tissue, adipose cells
  - outward: skin with hair, sebaceous, sweat and aromatic glands
  - inward: hair are missing, present glands
- labia minora
  - no adipose cells
  - stratified squamous epithelium – slightly keratinized
  - sebaceous glands → smegma preputii
- rima pudendi
- commissura labiorum anterior + posterior

# Vaginal vestibule

## *Vestibulum vaginae*

- ostium urethrae externum
- ostium vaginae
- ostia glandularium vestibularium

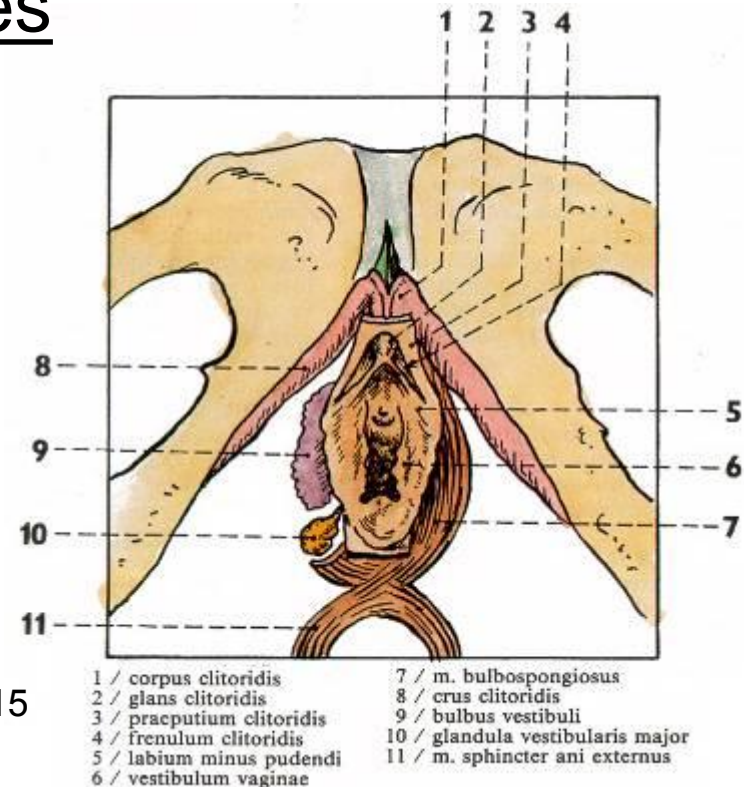


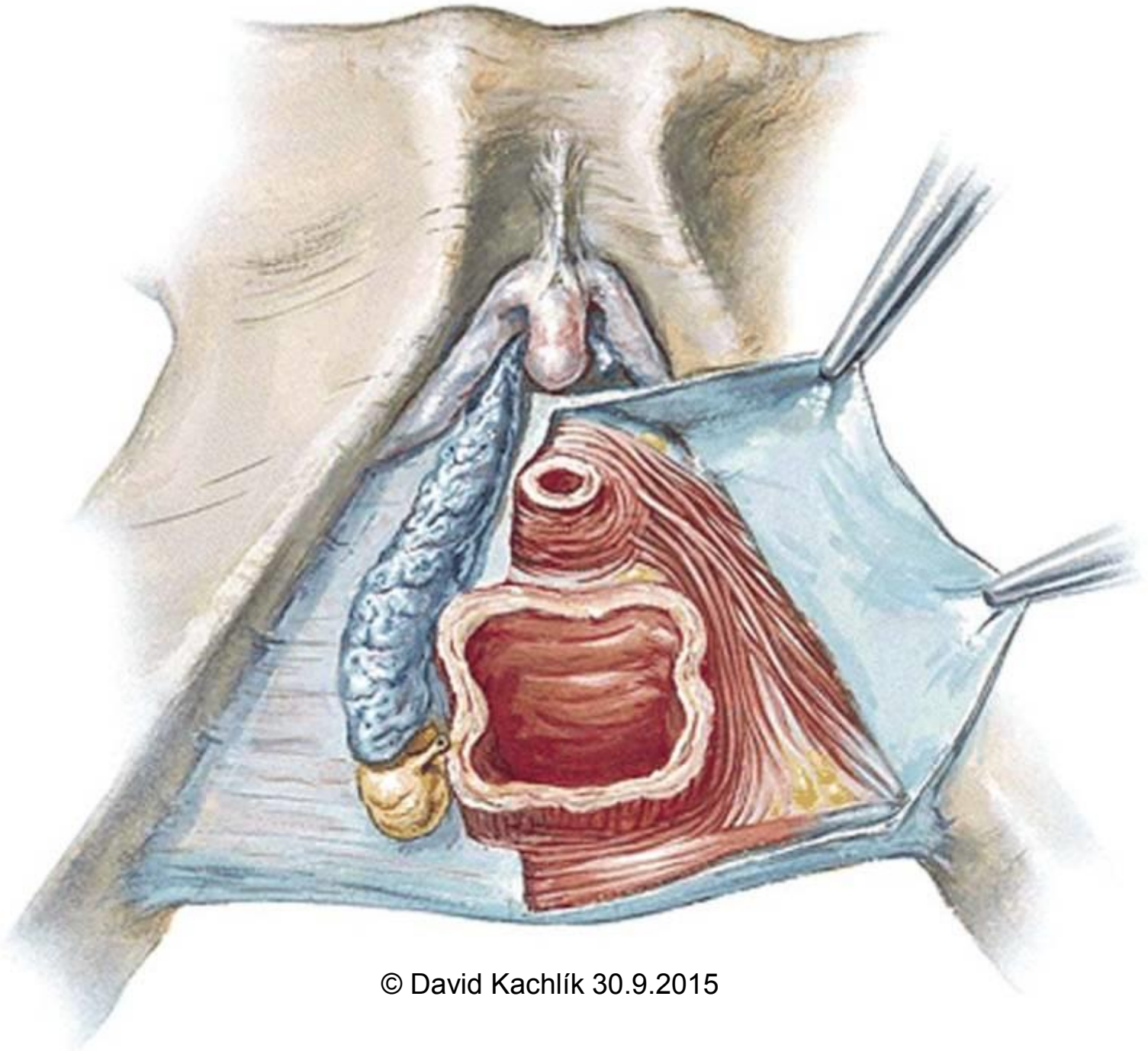
# Glands and cavernous bodies

- glandulae vestibulares majores *Bartholini*
  - paired, pea-shaped large
  - from below in membrana perinei
  - tubulo-alveolar and mucous glands
- glandulae vestibulares minores

## cavernous bodies:

- clitoris (f.)
- paired cavernous bodies
  - surrounded by tunica albuginea
- bulbus vestibuli
  - paired spongy body
  - commissura bulborum





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# External genitalia – *blood supply*

## Arteries:

- a. femoralis → aa. pudendae ext. → rr. labiales ant.
- a. iliaca int. → a. pudenda int. → rr. labiales post., a. profunda clitoridis, a. dorsalis clitoridis, a. bulbi vestibuli

## Veins:

- v. dorsalis superficialis clitoridis + vv. labiales ant. → vv. pudendae ext. → v. saphena magna → v. femoralis communis
- v. dorsalis profunda clitoridis + vv. labiales post. + v. bulbi vestibuli → v. pudenda int. → v. iliaca int.

# External genitalia

## *lymph + nerves*

### Lymphatic drainage:

- nn.ll. inguinales superficiales  
(even cross the midline)

### Nerves:

- n. ilioinguinalis
- r. genitalis n. genitofemoralis
- n. pudendus → nn. perineales, nn. labiales post., n. dorsalis clitoridis

# Perineum

- **corpus perineale** (*centrum tendineum perinei*)
- **mm. perinei** = perinael muscles
- corpus / lig. anococcygeum
- membrana perinei
- trigonum urogenitale et anale
- fossa ischioanalis
  - recessus pubicus
  - canalis pudendalis *Alcocki*
  - corpus adiposum fossae ischioanalis

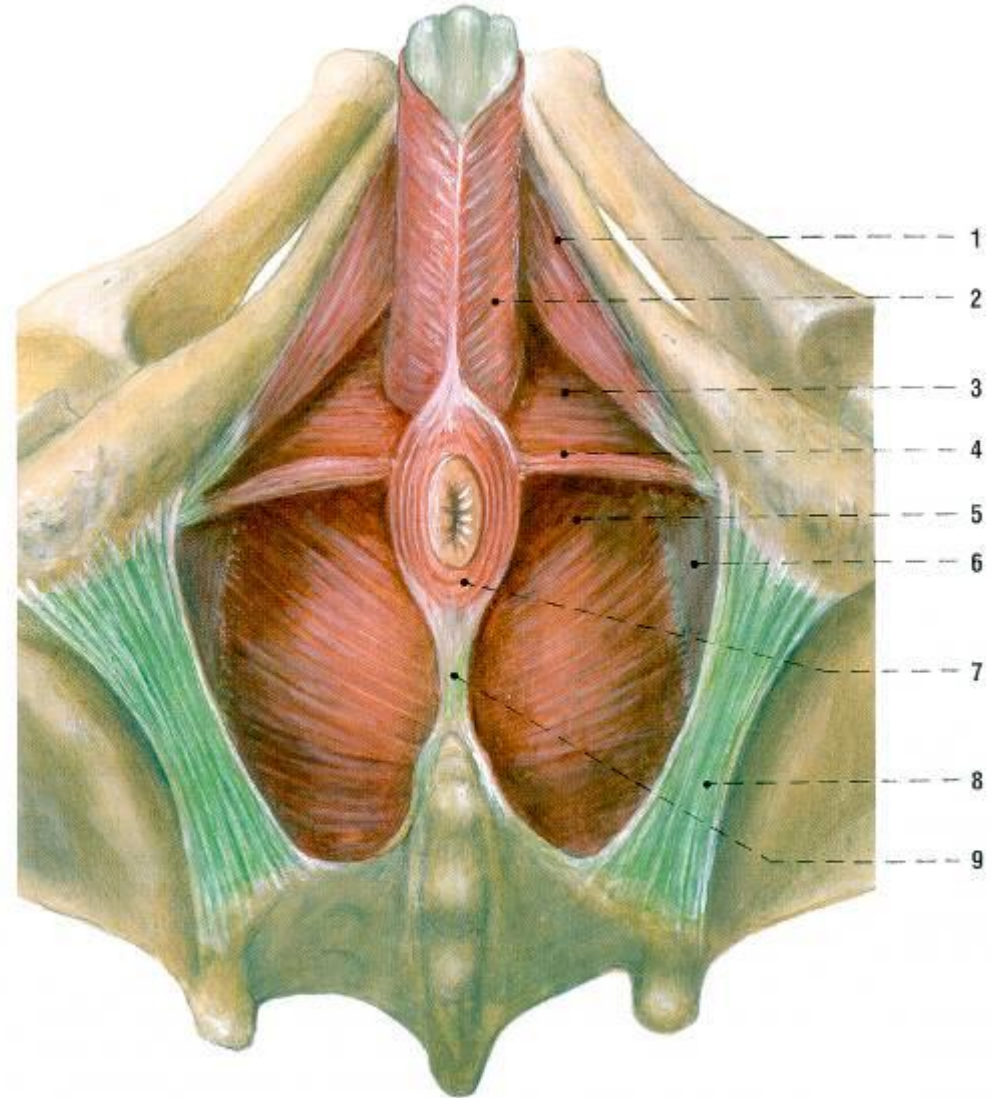
# Urogenital floor

- = diaphragma urogenitale
- **NOT PROPER TERM** of Terminologia Anatomica 1998
- fits for illustration
- **perineal muscles = *musculi perinei*** according to TA 1998
- 4 muscles in line = „floor“
- + 3 ♀ / 1 ♂ another muscles around urethra
- its centre is **corpus perineale**

# Svaly dna pánevního a mčopohlavního muže žabí perspektiva



- m. transversus perinei profundus
- m. transversus perinei superficialis
- m. bulbospongiosus
- m. ischiocavernosus
- m. sphincter urethrae externus



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1 m. ischiocavernosus

2 m. bulbospongiosus

3 diaphragma urogenitale

4 m. transversus perinei superficialis

5 m. levator ani

6 m. obturatorius internus a jeho fascie

7 m. sphincter ani externus

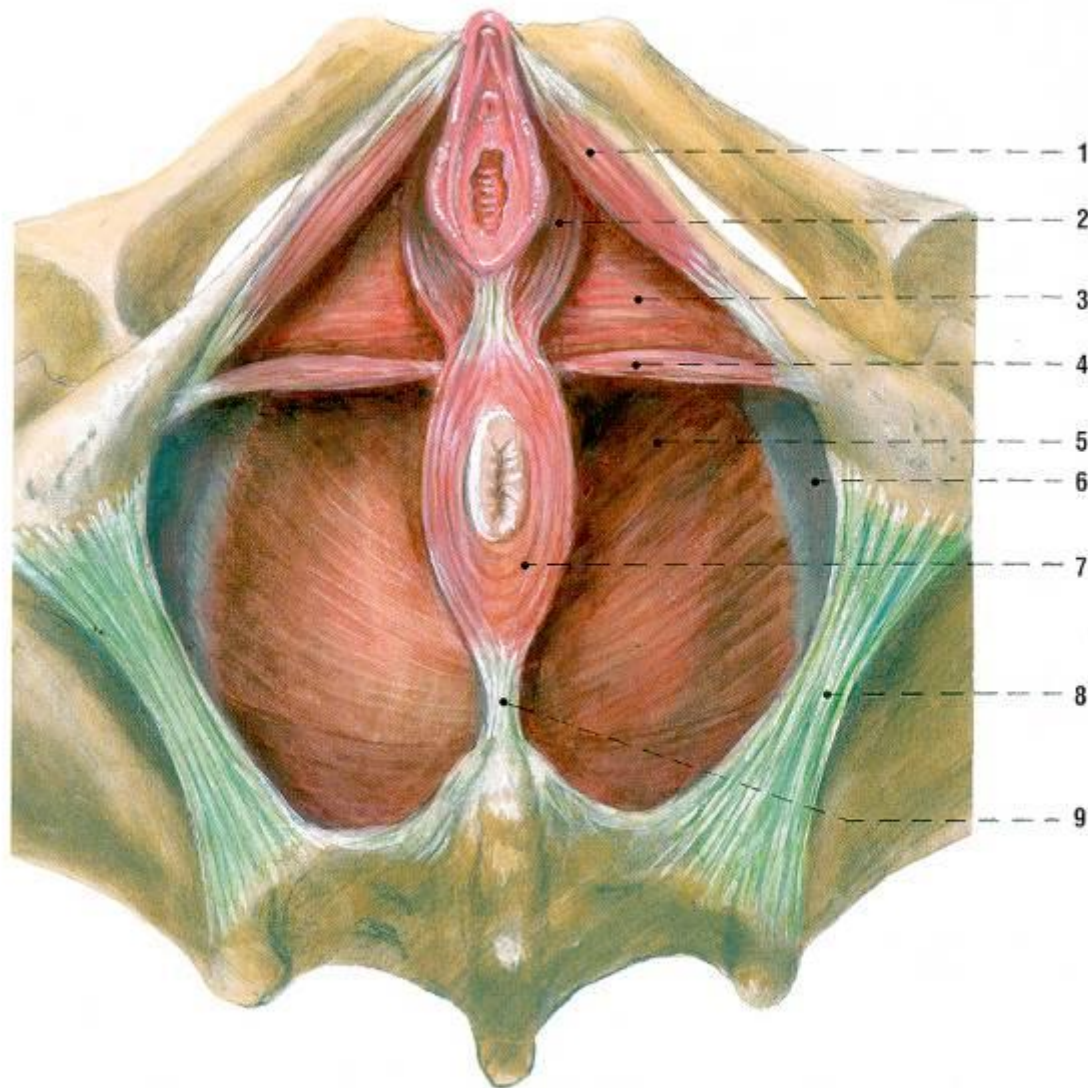
8 lig. sacrotuberale

9 lig. anocecygeum

# Svaly dna pánevního a močopohlavního ženy žabí perspektiva



- m. bulbospongiosus
- m. ischiocavernosus
- m. transversus perinei superficialis



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1 m. ischiocavernosus  
2 m. bulbospongiosus  
3 diaphragma urogenitale  
4 m. transversus perinei superficialis

5 m. levator ani  
6 m. obturatorius internus a jeho fascie  
7 m. sphincter ani externus  
8 lig. sacrotuberale  
9 lig. anococcygeum

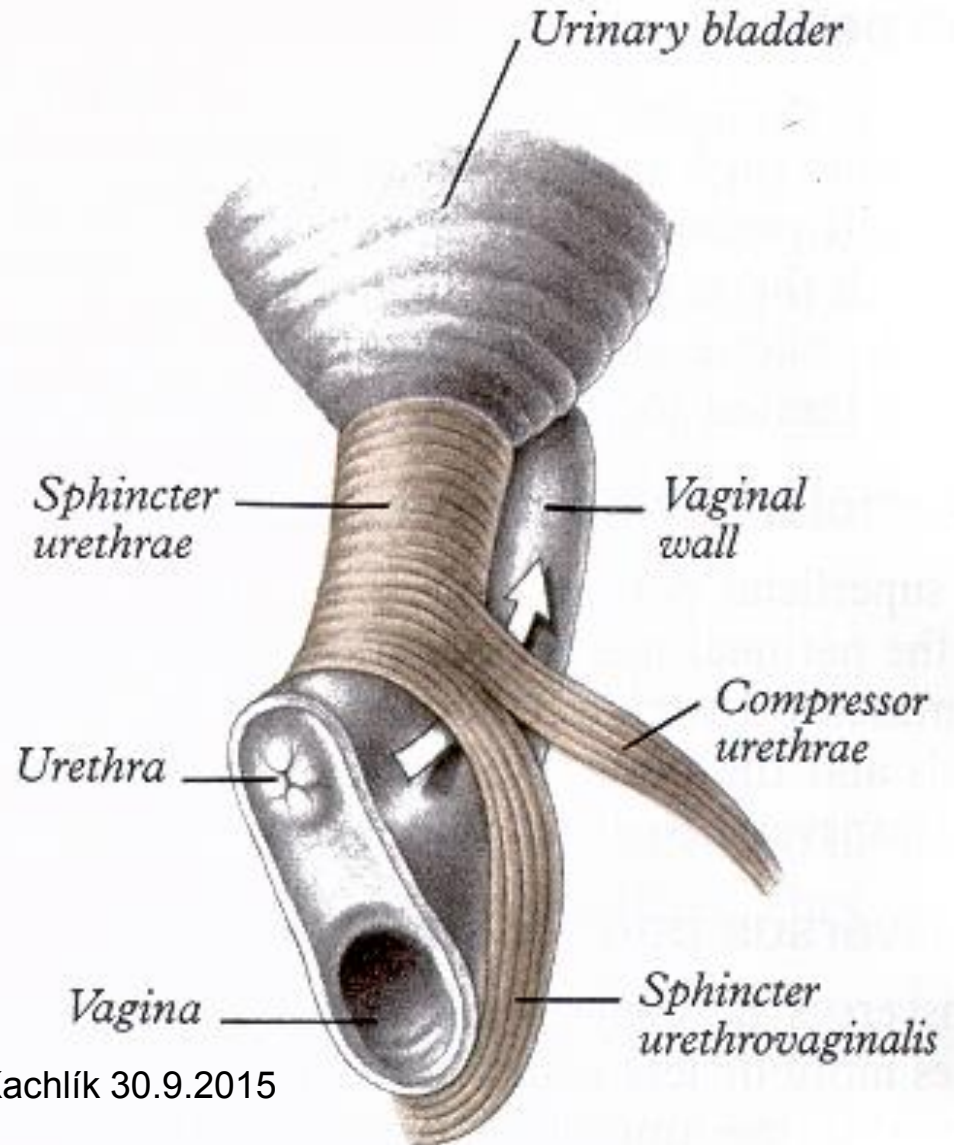
# Svaly močopovavního dna ženy



- m. sphincter urethrae



- m. sphincter urethrae
- m. compressor urethrae
- m. sphincter urethrovaginalis

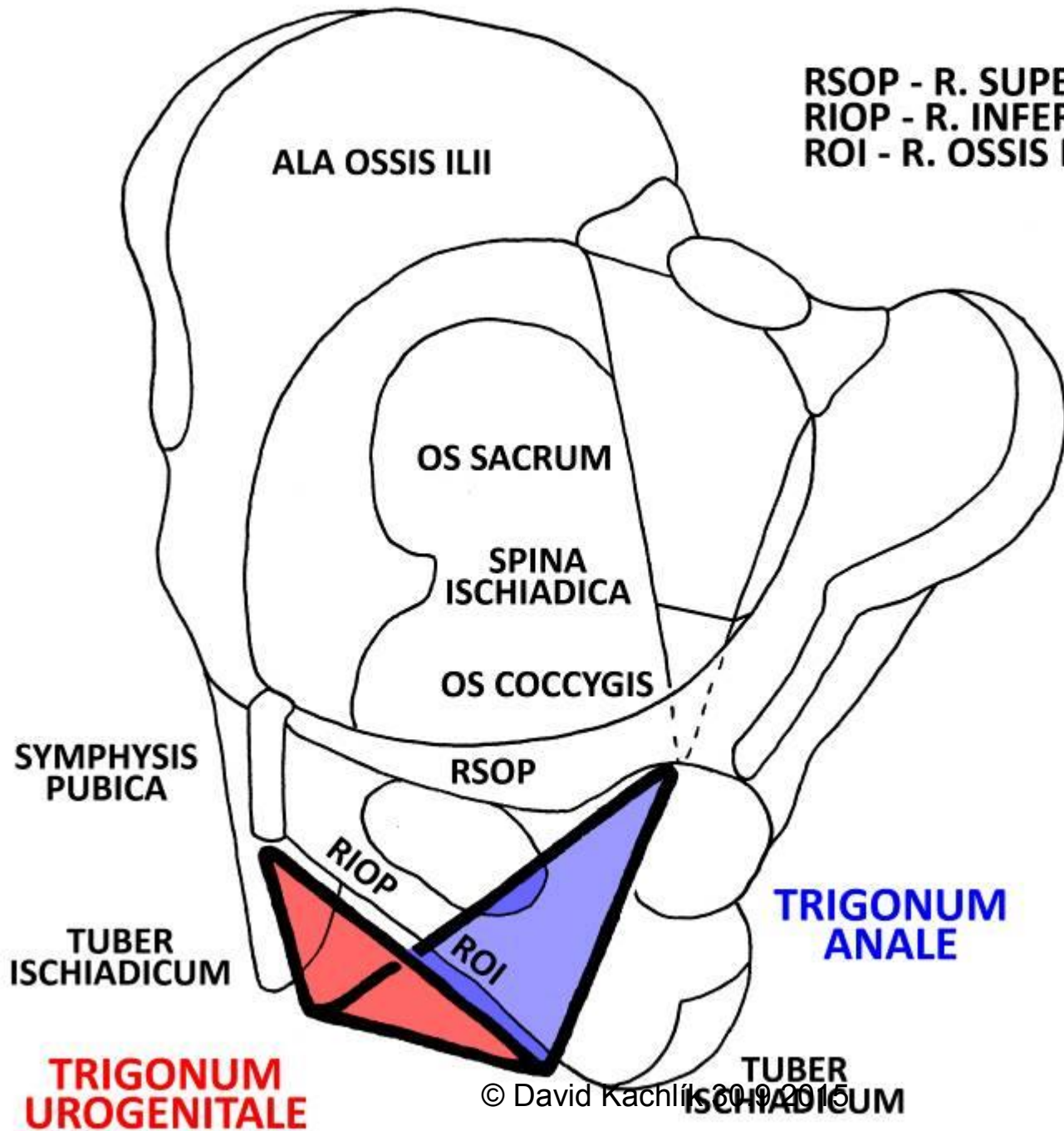


# Perineal muscles - *innervation*

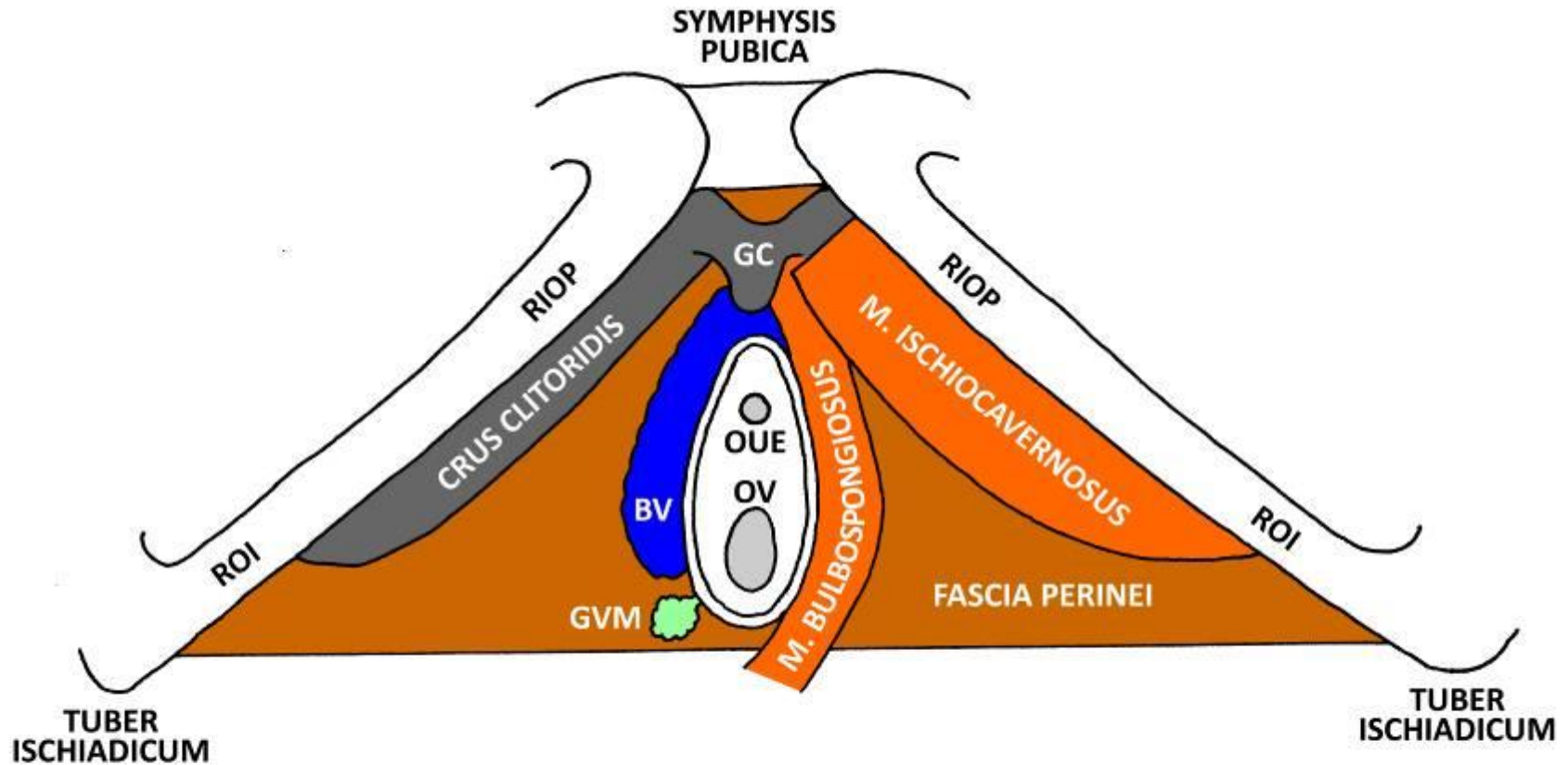
root S4

- nn. perineales n. pudendi
- rr. anteriores nn. sacralium
- nn. splanchnici sacrales





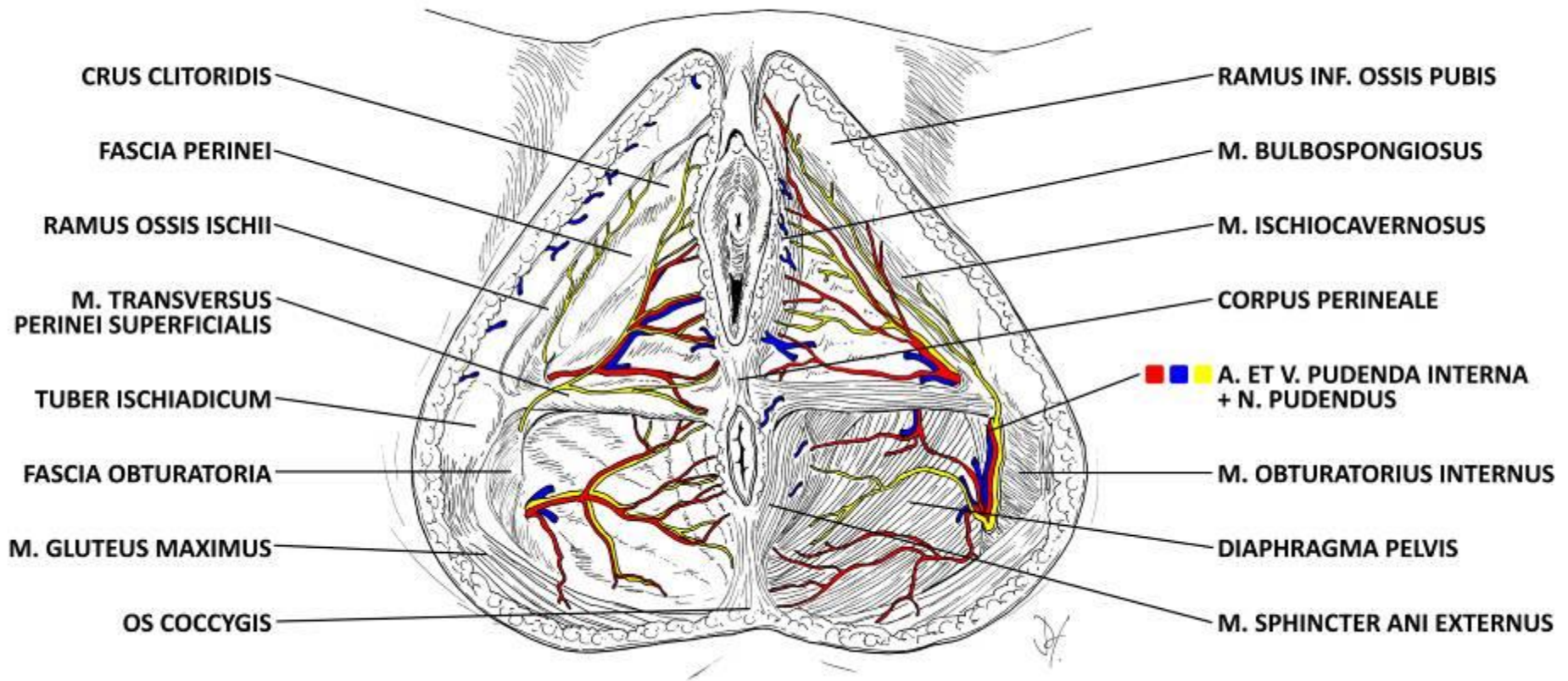
# Trigonum urogenitale ♀



RIOP - R. INF. OSSIS PUBIS  
ROI - R. OSSIS ISCHII  
GC - GLANS CLITORIDIS  
BV - BULBUS VESTIBULI  
OUE - OSTIUM URETHRAE EXTERNUM  
OV - ORIFICIUM VAGINAE  
GVM - GLANDULA VESTIBULARIS MAJOR

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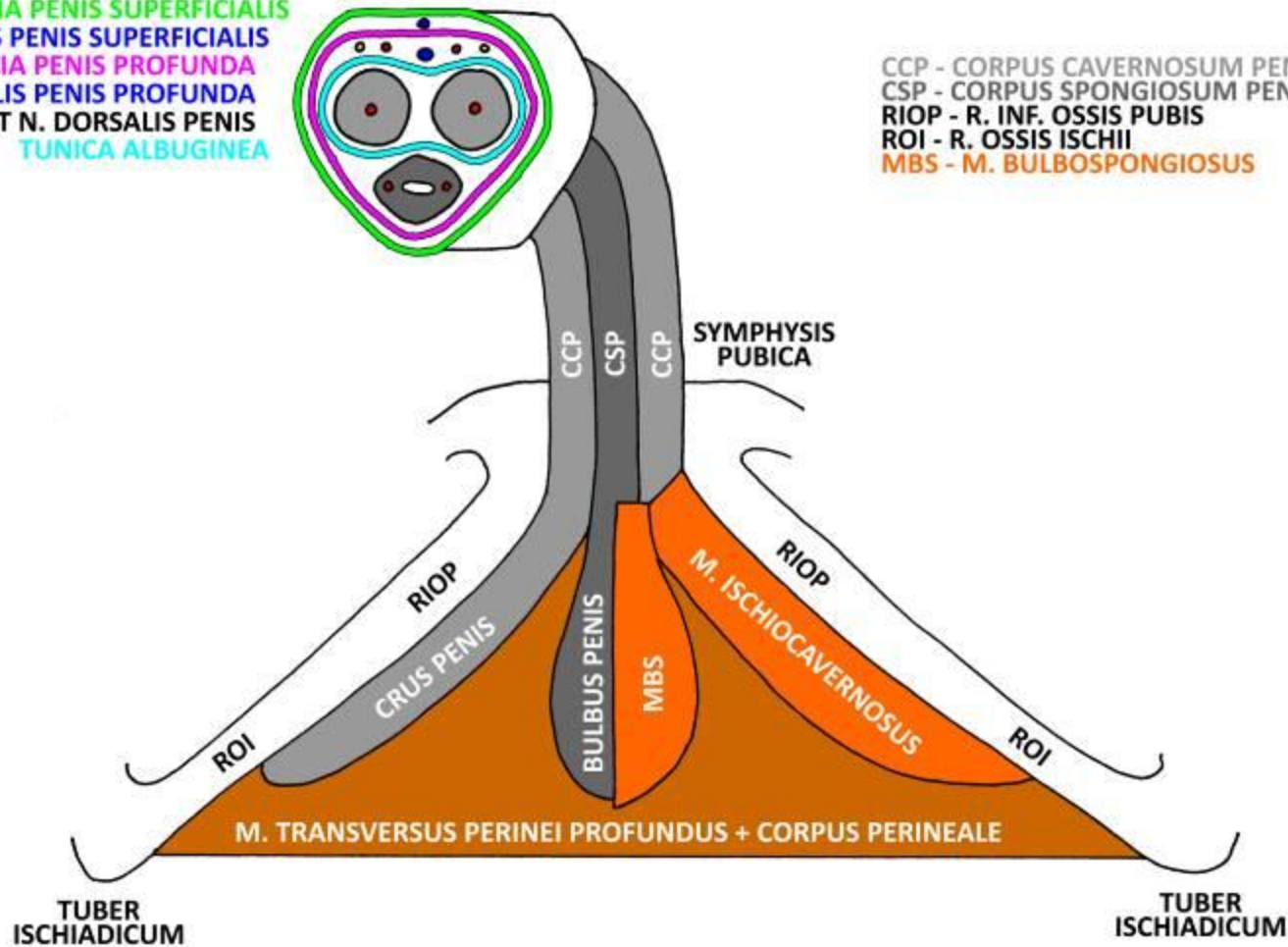
# Regio perinealis ♀



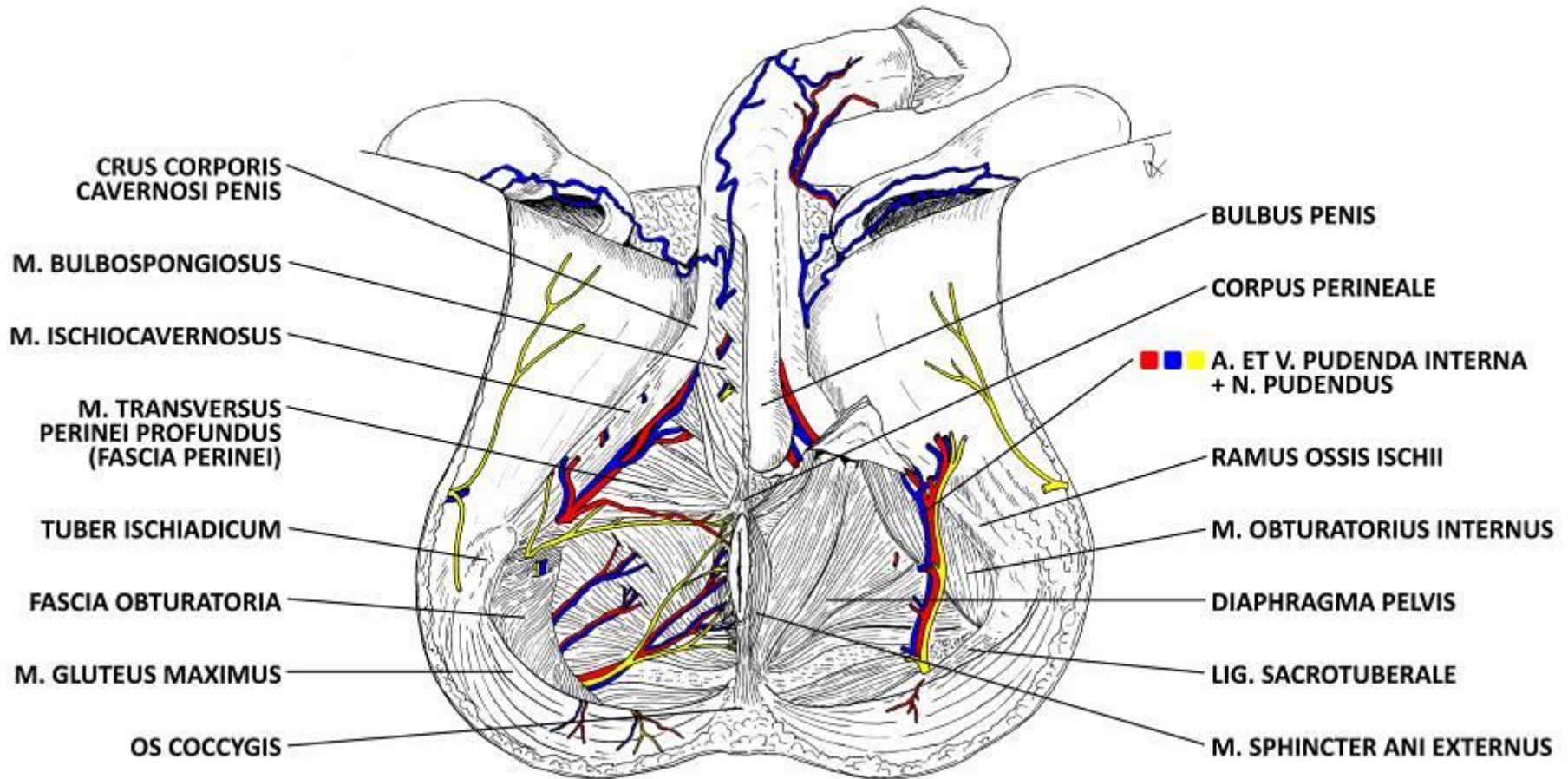
# Trigonum urogenitale ♂

**FASCIA PENIS SUPERFICIALIS**  
**V. DORSALIS PENIS SUPERFICIALIS**  
**FASCIA PENIS PROFUNDA**  
**V. DORSALIS PENIS PROFUNDA**  
**+ A. ET N. DORSALIS PENIS**  
**TUNICA ALBUGINEA**

**CCP - CORPUS CAVERNOSUM PENIS + A. PROFUNDA PENIS**  
**CSP - CORPUS SPONGIOSUM PENIS + AA. URETHRALES**  
**RIOP - R. INF. OSSIS PUBIS**  
**ROI - R. OSSIS ISCHII**  
**MBS - M. BULBOSPONGIOSUS**



# Regio perinealis ♂



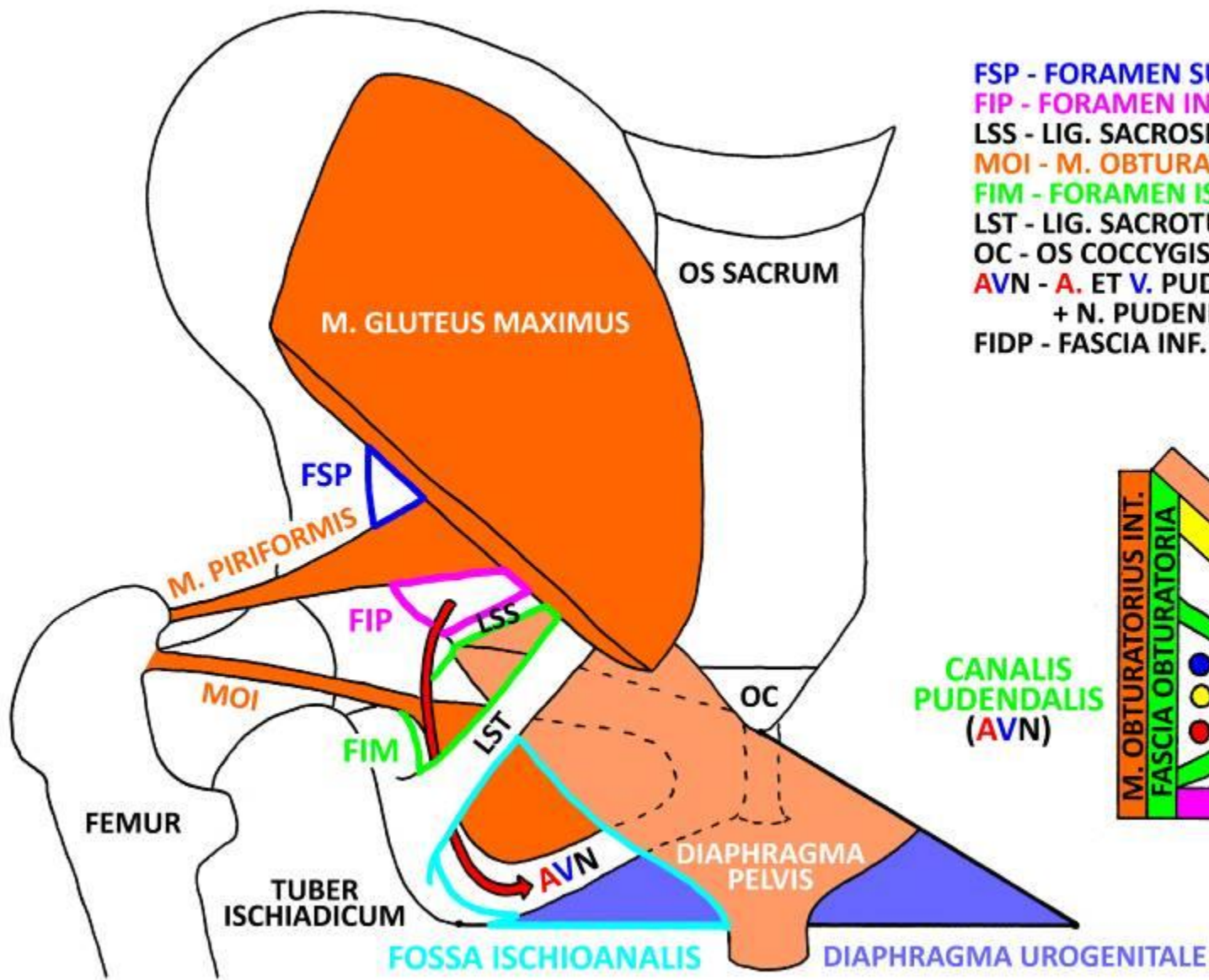
# Fossa ischioanal

## Boundaries:

- **MEDIOCRANIALY + CRANIALY:** m. sphincter ani externus, fascia inferior diaphragmatis pelvis
- **LATERALLY:** tuber ischiadicum, fascia obturatoria
- **DORSALLY:** lower margin of m. gluteus maximus, lig. sacrotuberale
- **CAUDALLY:** fascia perinei superficialis

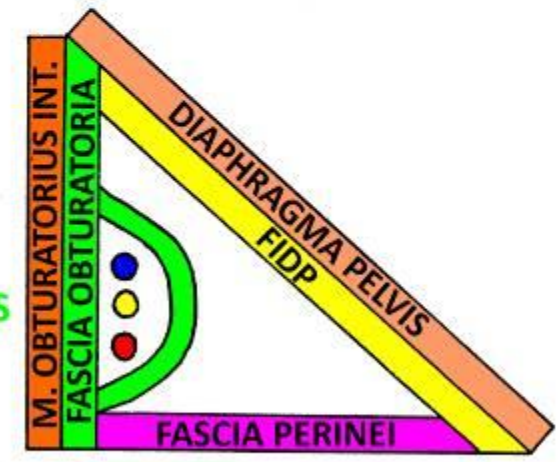
## CONTENT:

- canalis pudendalis (*Alcocki*)
- corpus adiposum fossae ischioanal
- paired recessus pubicus extends ventrally above trigonum urogenitale up to symphysis pubica

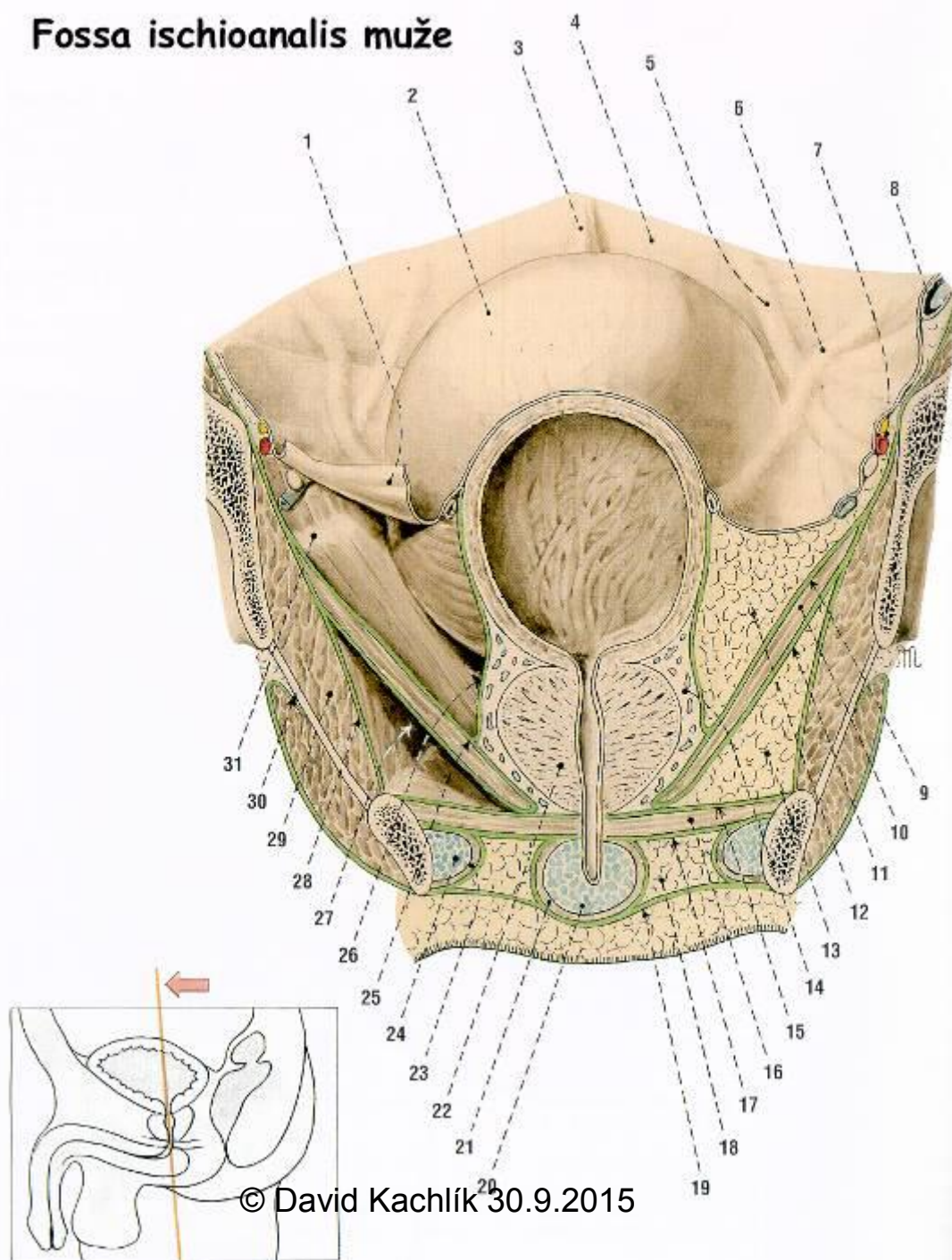


- FSP - FORAMEN SUPRAPIRIFORME
- FIP - FORAMEN INFRAPIRIFORME
- LSS - LIG. SACROSPINALE
- MOI - M. OBTURATORIUS INTERNUS
- FIM - FORAMEN ISCHIADICUM MINUS
- LST - LIG. SACROTUBERALE
- OC - OS COCCYGIS
- AVN - A. ET V. PUDENDA INTERNA  
+ N. PUDENDUS
- FIDP - FASCIA INF. DIAPHRAGMATIS PELVIS

CANALIS  
PUDENDALIS  
(AVN)



# Fossa ischioanalis muže



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# Fossa ischioanalis ženy

