Organa genitalia feminina

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Female reproductive system

- Paired ovaries
- Uterine tubes (fallopian tubes)
- Uterus
- Vagina

- Labia majora
- Labia minora
- Clitoris

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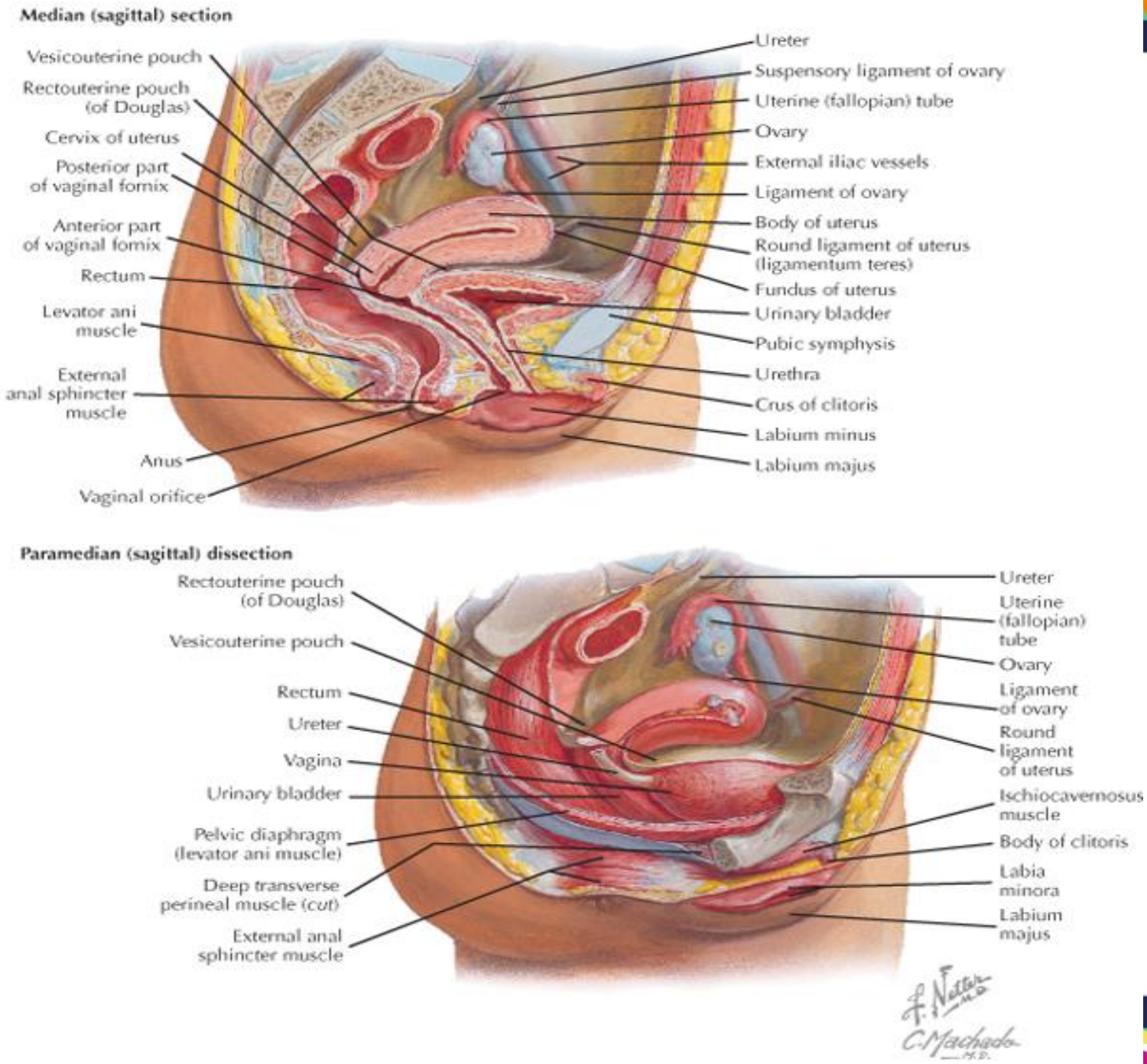
Topography of the female pelvic viscera: medial and paramedial sagittal views.



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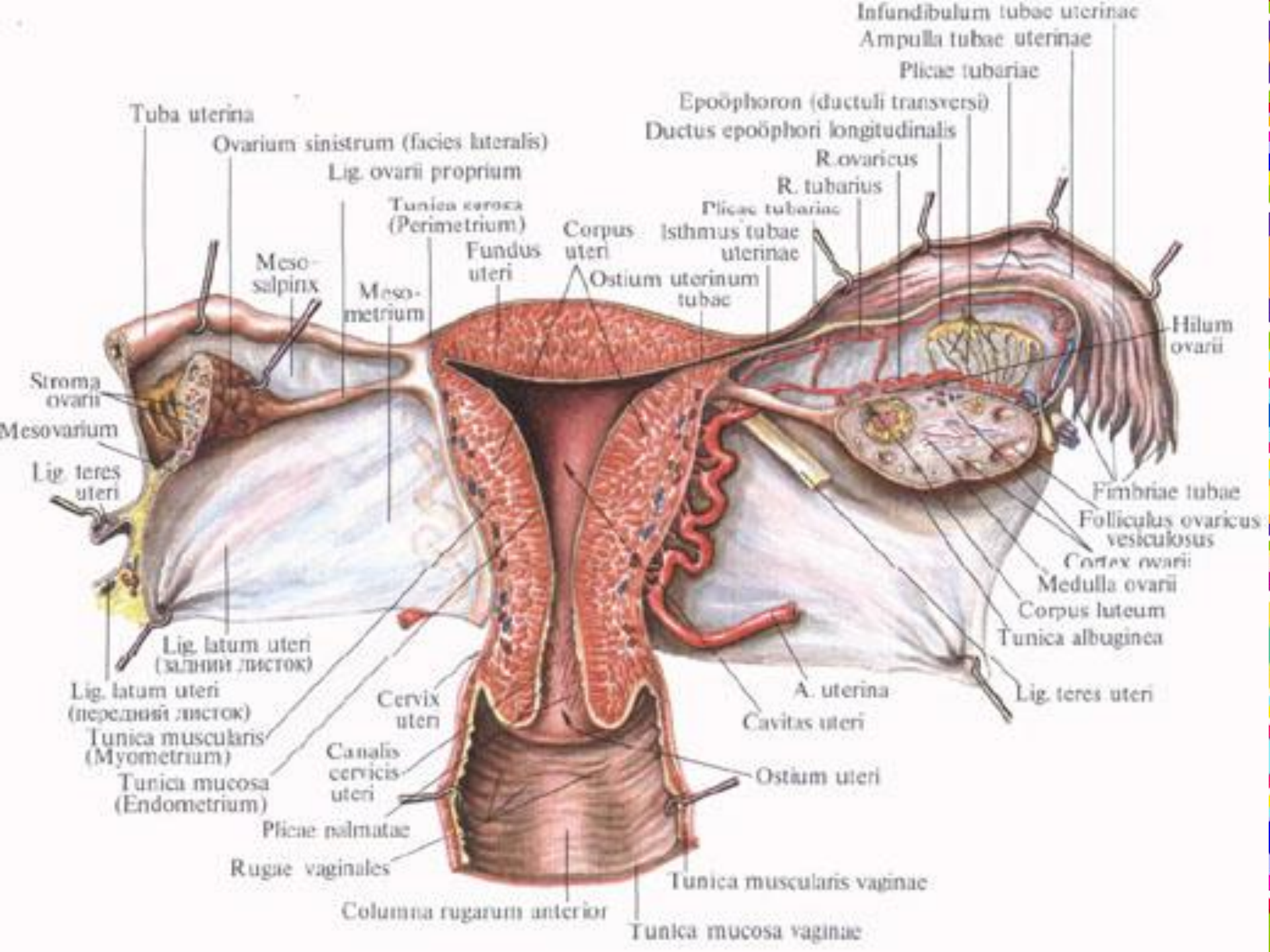
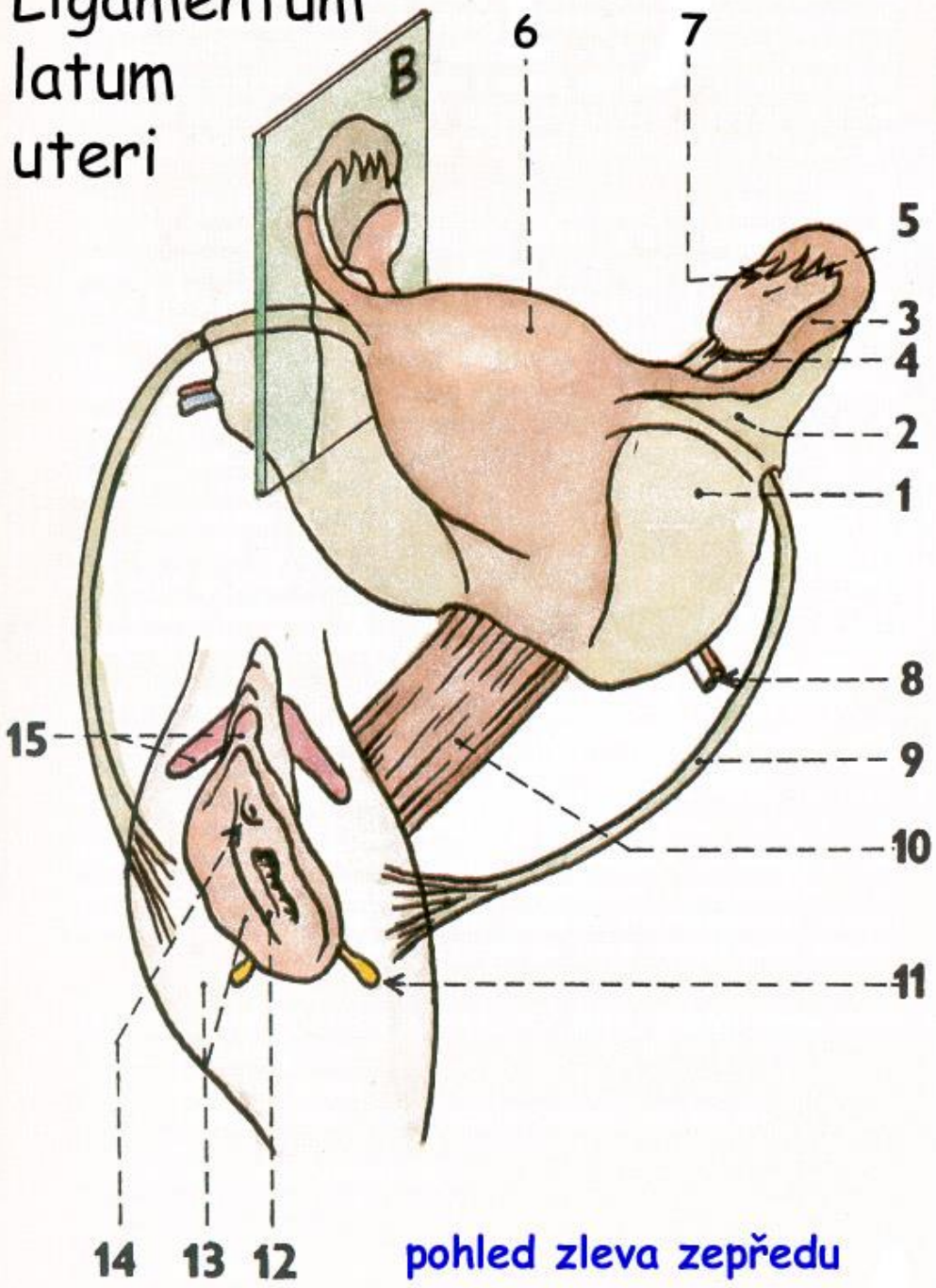
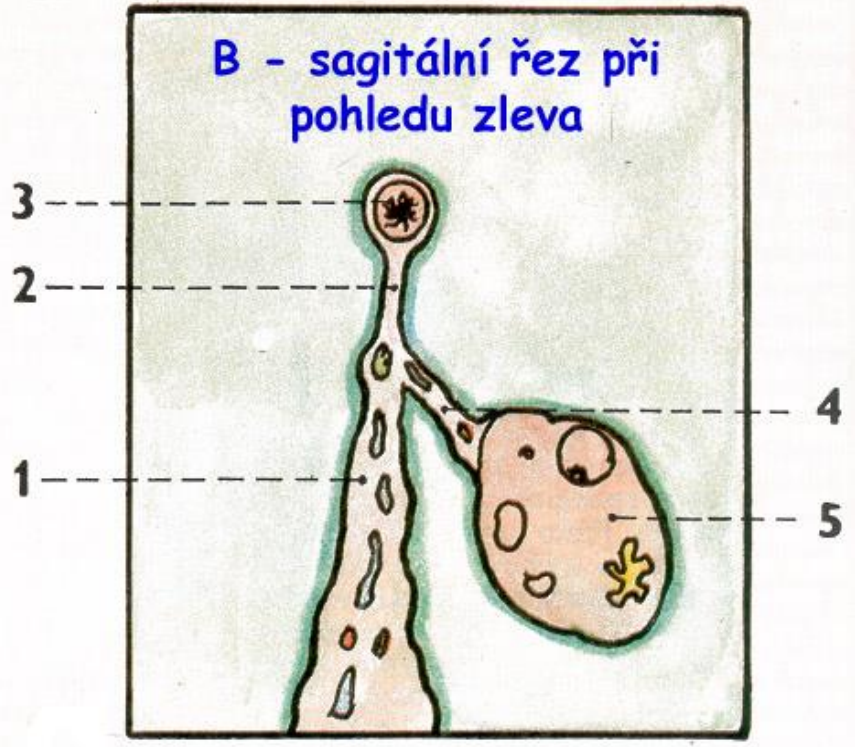

Infundibulum tubae uterinae
Ampulla tubae uterinae
Plicae tubariae
Epoöphoron (ductuli transversi)
Ductus epoöphori longitudinalis
R. ovaricus
R. tubarius
Plicae tubariae
Tuba uterina
Ovarium sinistrum (facies lateralis)
Lig. ovarii proprium
Tunica serosa (Perimetrium)
Corpus uteri
Isthmus tubae uterinae
Meso-salpinx
Meso-metrium
Fundus uteri
Ostium uterinum tubae
Hilum ovarii
Stroma ovarii
Mesovarium
Lig. teres uteri
Fimbriae tubae
Folliculus ovaricus vesiculosus
Cortex ovarii
Medulla ovarii
Corpus luteum
Tunica albuginea
Lig. latum uteri (задний листок)
Lig. latum uteri (передний листок)
A. uterina
Lig. teres uteri
Cervix uteri
Cavitas uteri
Tunica muscularis (Myometrium)
Canalis cervicis uteri
Ostium uteri
Tunica mucosa (Endometrium)
Plicae palmatae
Rugae vaginales
Tunica muscularis vaginae
Columna rugarum anterior
Tunica mucosa vaginae

Ligamentum latum uteri



pohled zleva zepředu



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

Ovaries

- Almond-shaped glands (3x2x1cm)
- **Ovarian surface epithelium**
  - Germinal epithelium (misnomer)
    - **These cells are not source of ova!!!**
    - Modified mesothelial cells
    - Simple cuboidal epithelium
- **Tunica albuginea**
  - Fibrous connective tissue under the epithelium

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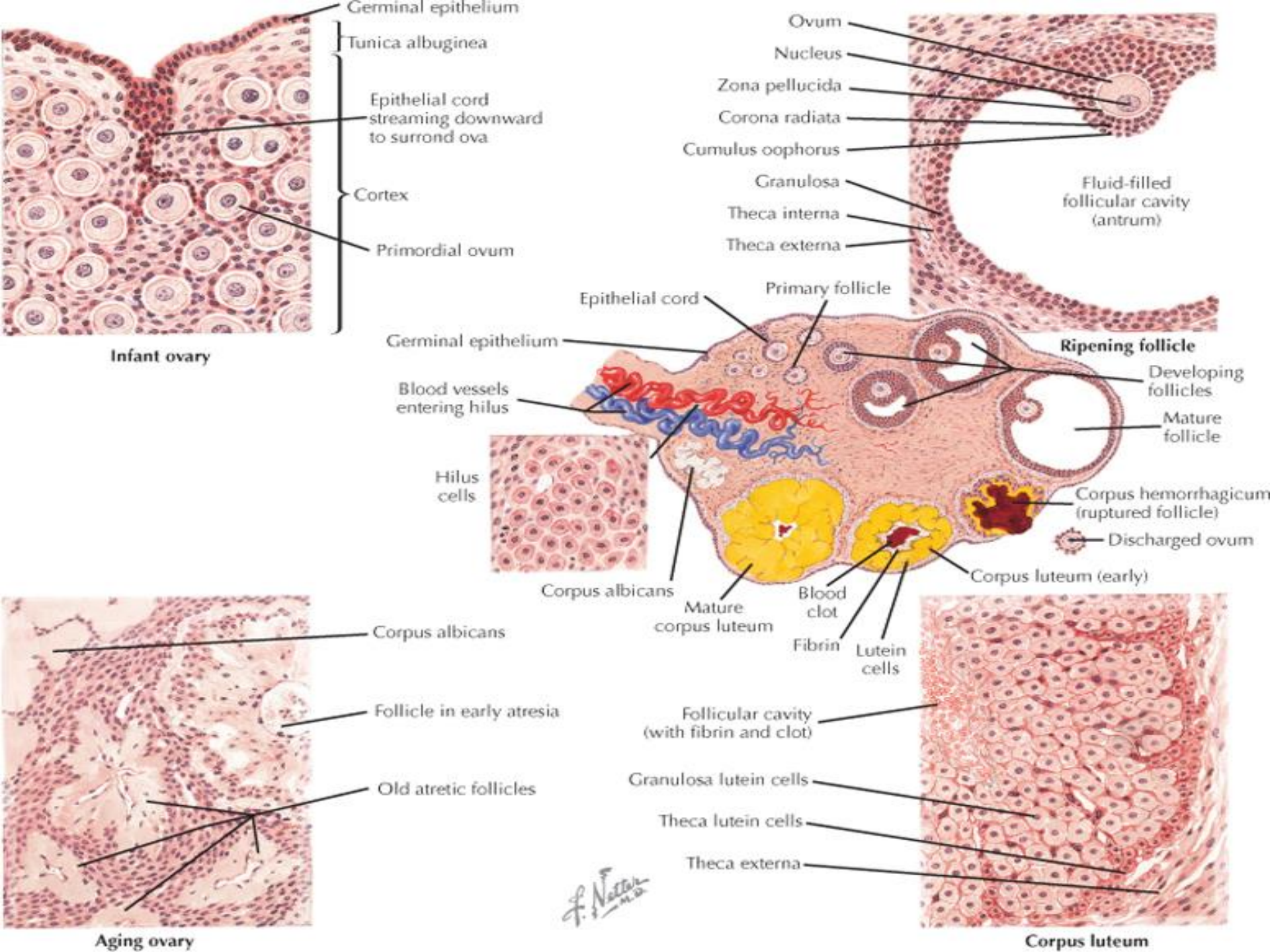
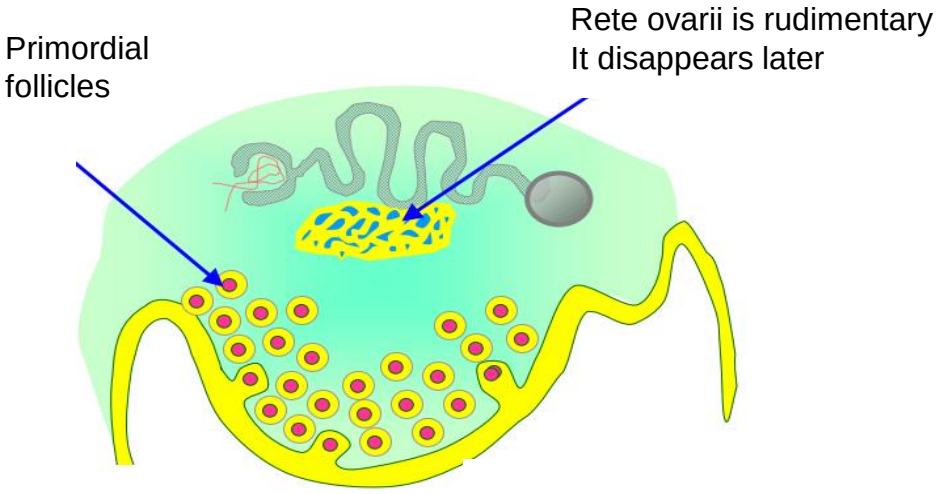

Germinal epithelium
Tunica albuginea
Epithelial cord streaming downward to surrond ova
Cortex
Primordial ovum
Infant ovary
Ovum
Nucleus
Zona pellucida
Corona radiata
Cumulus oophorus
Granulosa
Theca interna
Theca externa
Fluid-filled follicular cavity (antrum)
Ripening follicle
Epithelial cord
Primary follicle
Germinal epithelium
Developing follicles
Blood vessels entering hilus
Mature follicle
Hilus cells
Corpus hemorrhagicum (ruptured follicle)
Discharged ovum
Corpus albicans
Mature corpus luteum
Blood clot
Fibrin
Lutein cells
Corpus luteum (early)
Corpus albicans
Follicle in early atresia
Old atretic follicles
Aging ovary
Follicular cavity (with fibrin and clot)
Granulosa lutein cells
Theca lutein cells
Theca externa
Corpus luteum

Ovaries

- **Medulla** = inner part
- **Cortex** = outer part



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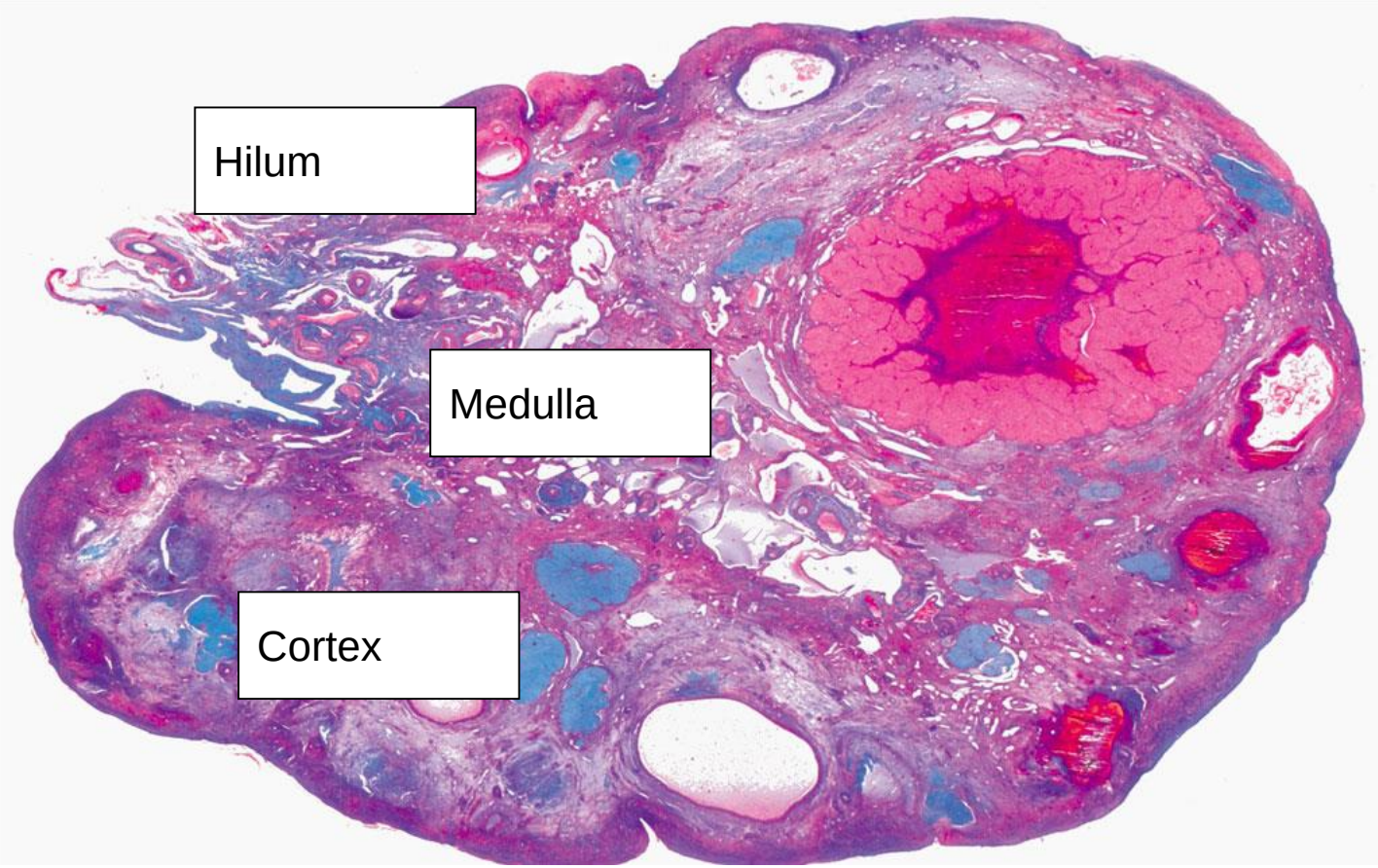
Ovaries



Cortex – contains follicles
Medulla – loose connective tissue and vessels

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Ovarian cortex

- **Ovarian surface epithelium**
- **Tunica albuginea**

- **Ovarian follicles**
  - Various size and different stages of maturation
- **Connective tissue stroma**
  - Special fibroblasts, collagen and reticular fibres, smooth muscle cells

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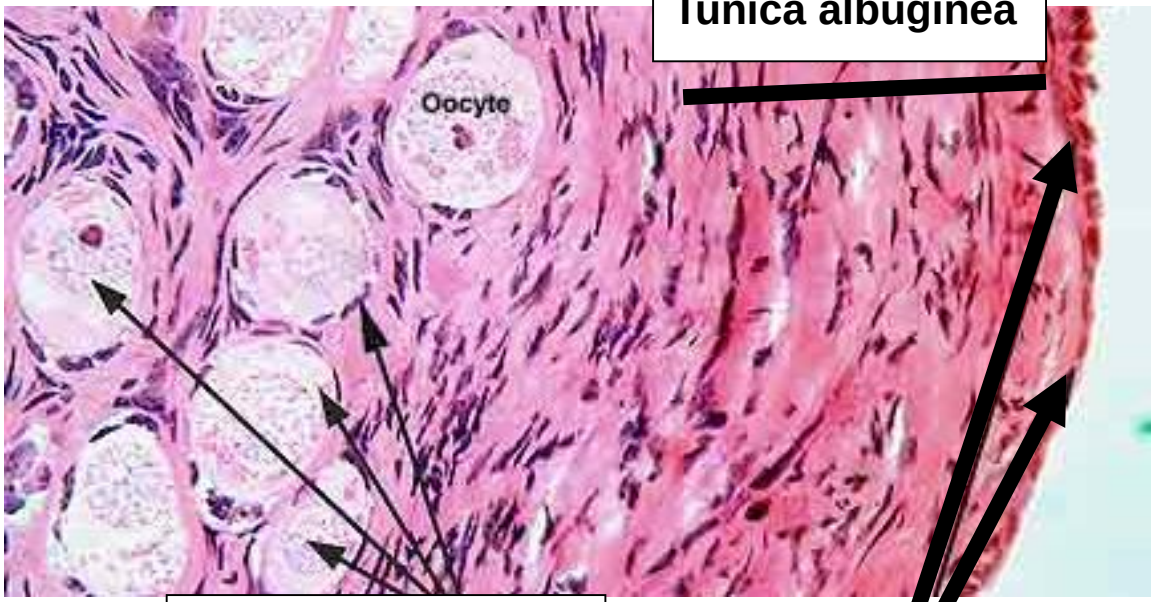

The epithelium used to be called **germinal.**
Since oocytes are not derived from the epithelium, this term is no longer used.
The origin is **mesothelium.**

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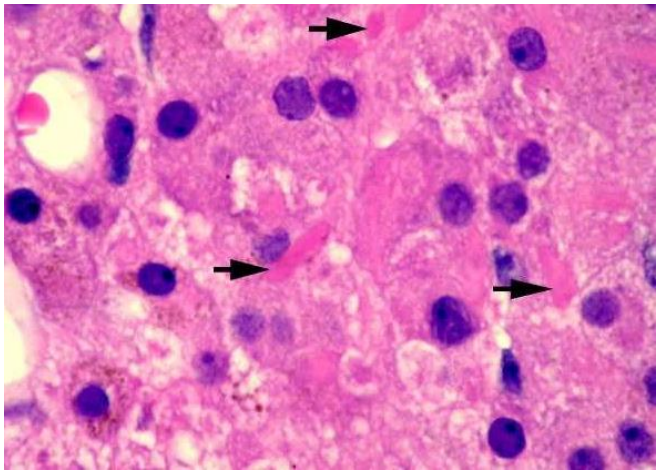
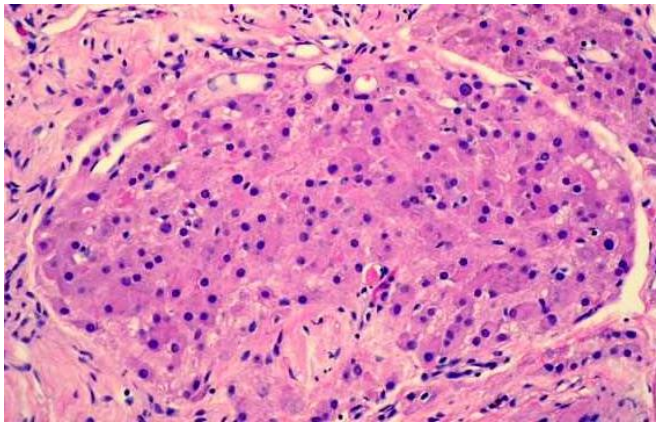
Ovarian medulla

- Loose connective tissue
- Nerves
- Blood vessles
- Lymphatic
- **Ovarian hilus cells**





- **No ovarian follicles here!!!**

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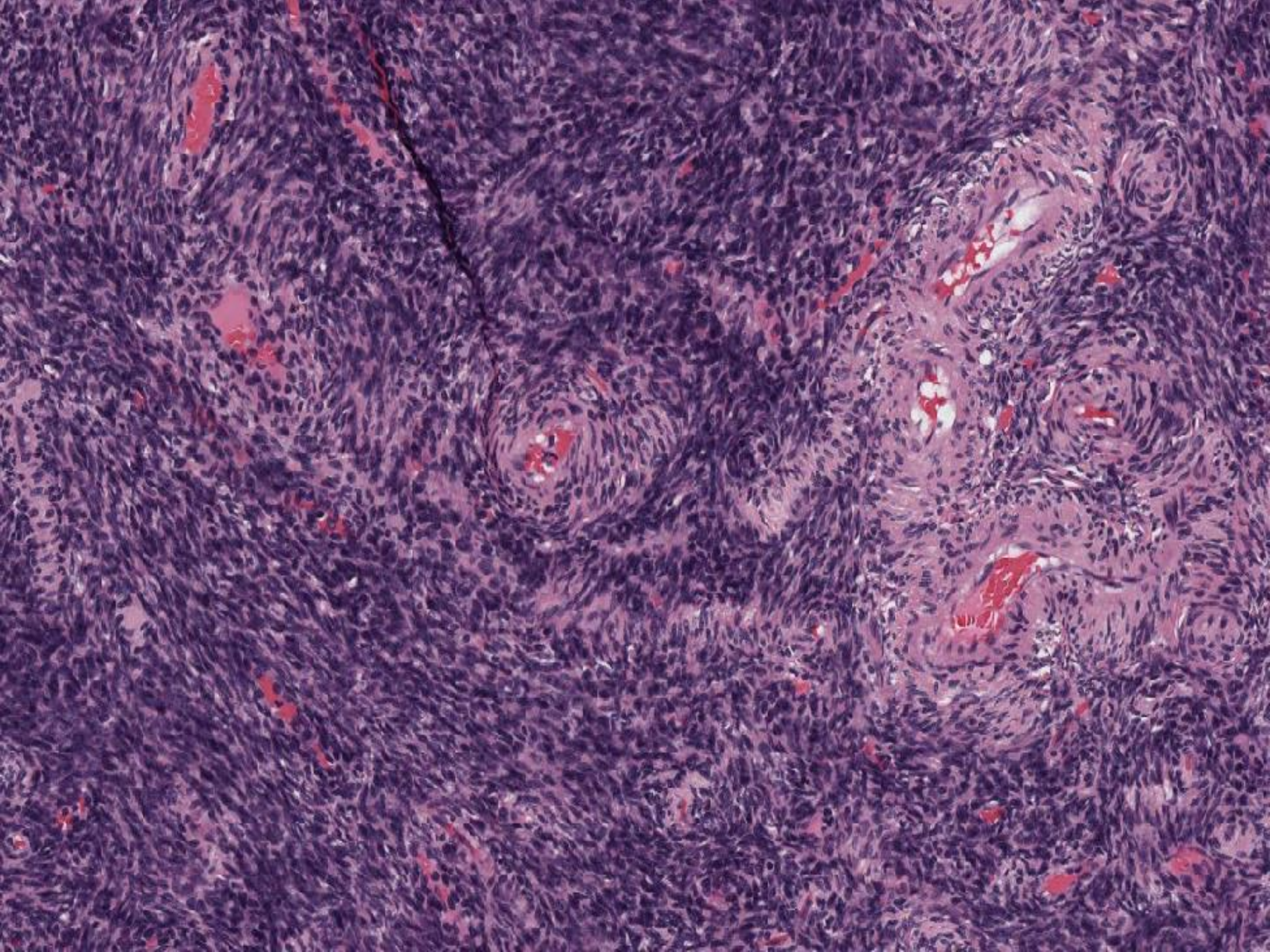
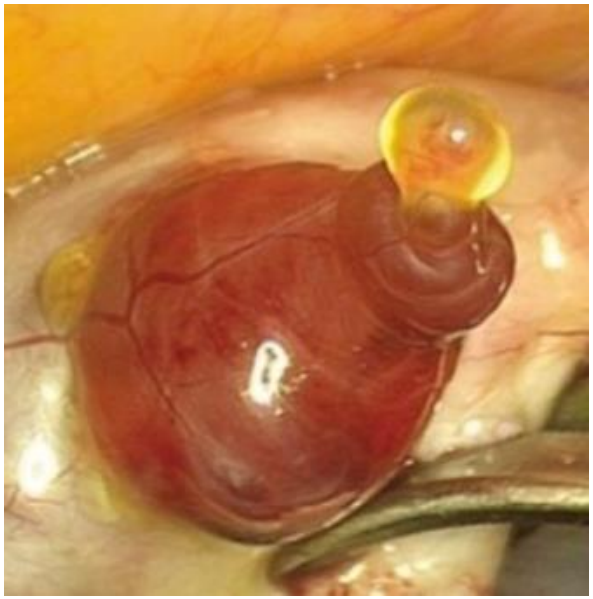


Ovarian follicles

- One oocyte
- Layer/s of follicular cells



- Primordial follicle
- Primary follicle
  - Unilaminar
  - Multilaminar
- Secondary / preantral follicle
- Tertiary / antral follicle
- Graafian follicle

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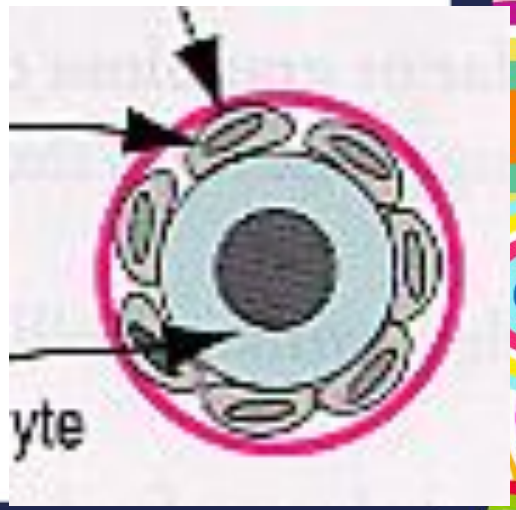
Primordial follicles

- **Oocyte**
  - Big eccentric nucleus
- One layer of squamous epithelial cells
  = **follicular cells**
- Just below the tunica albuginea



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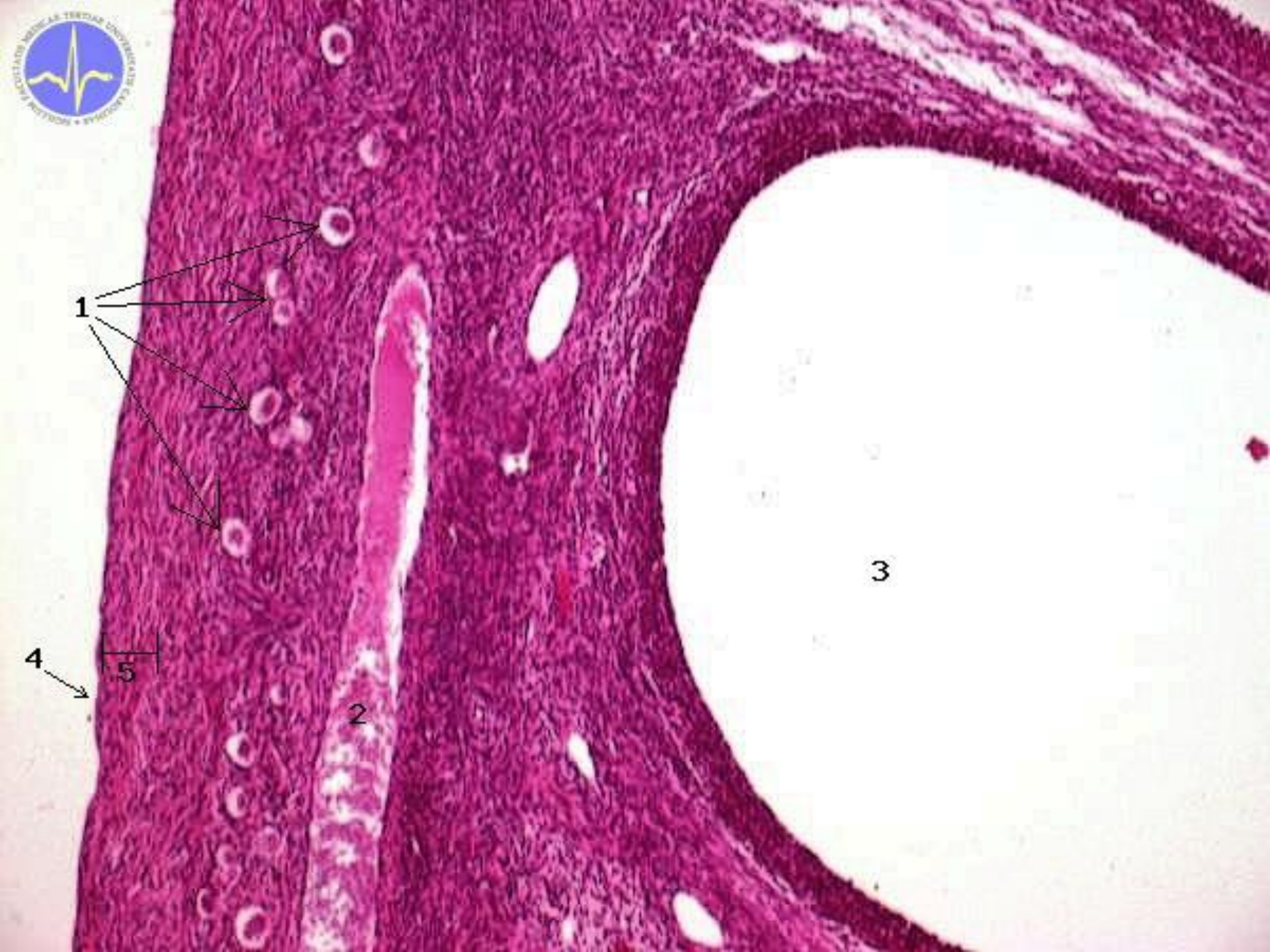
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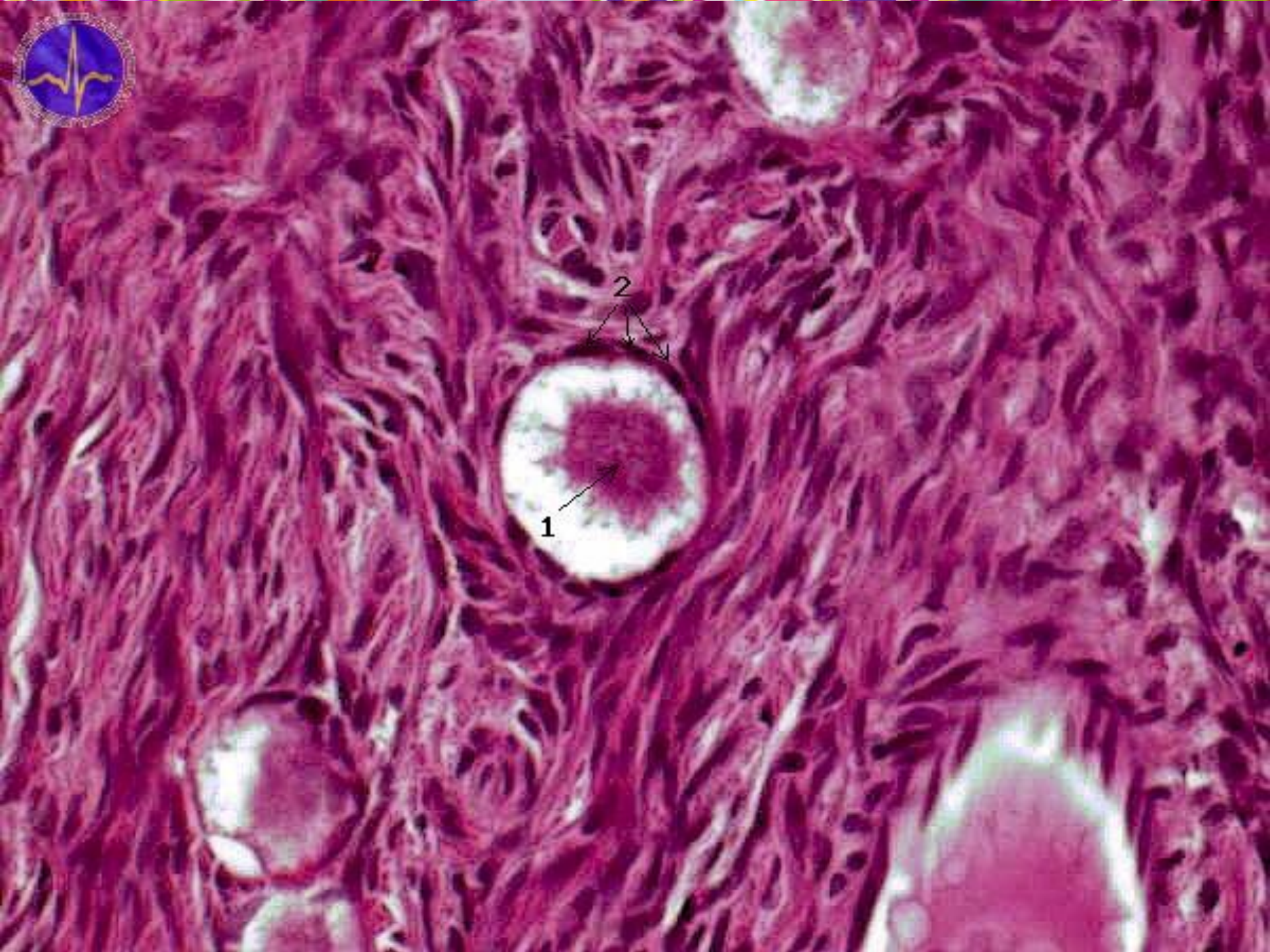
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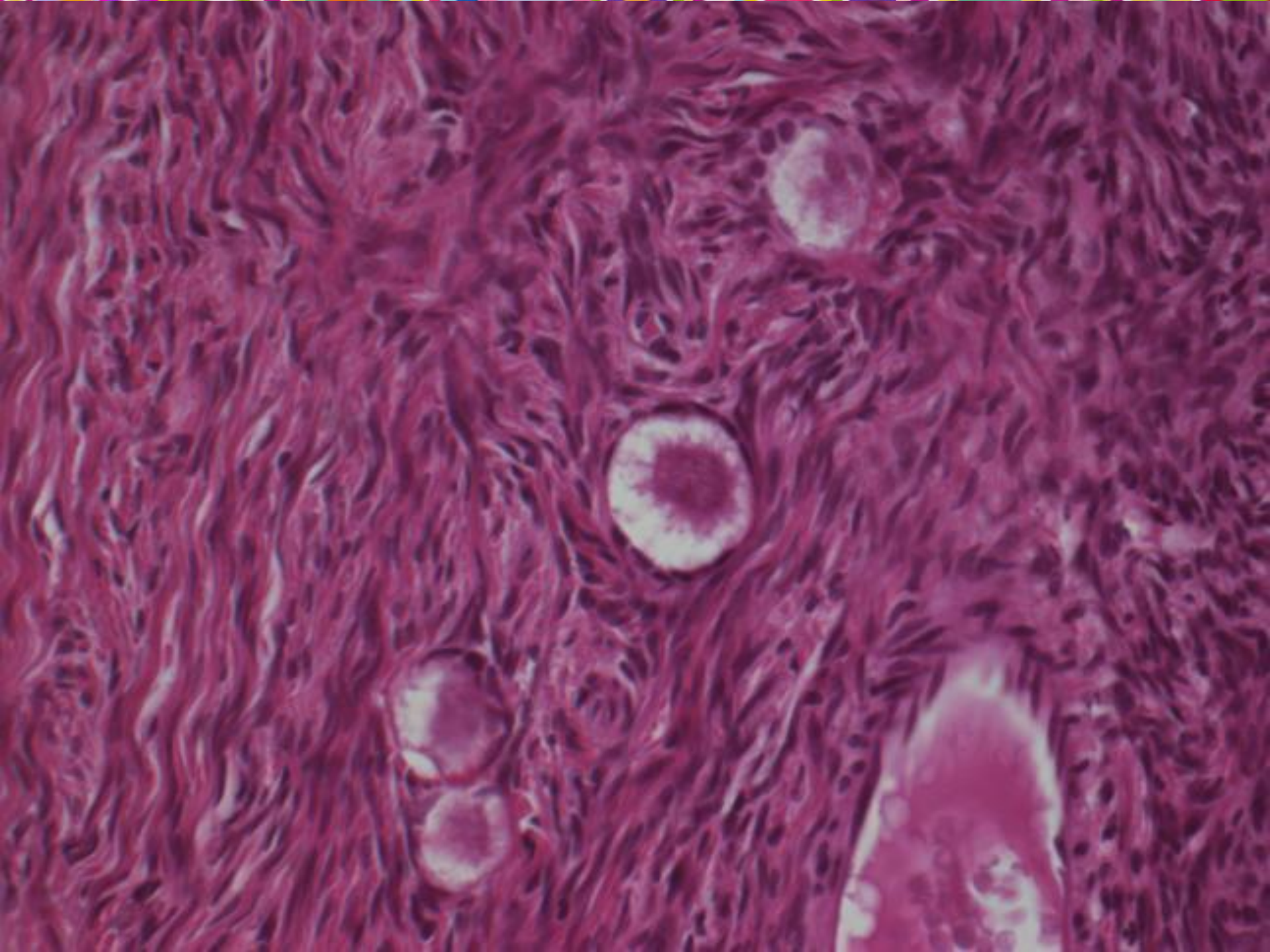

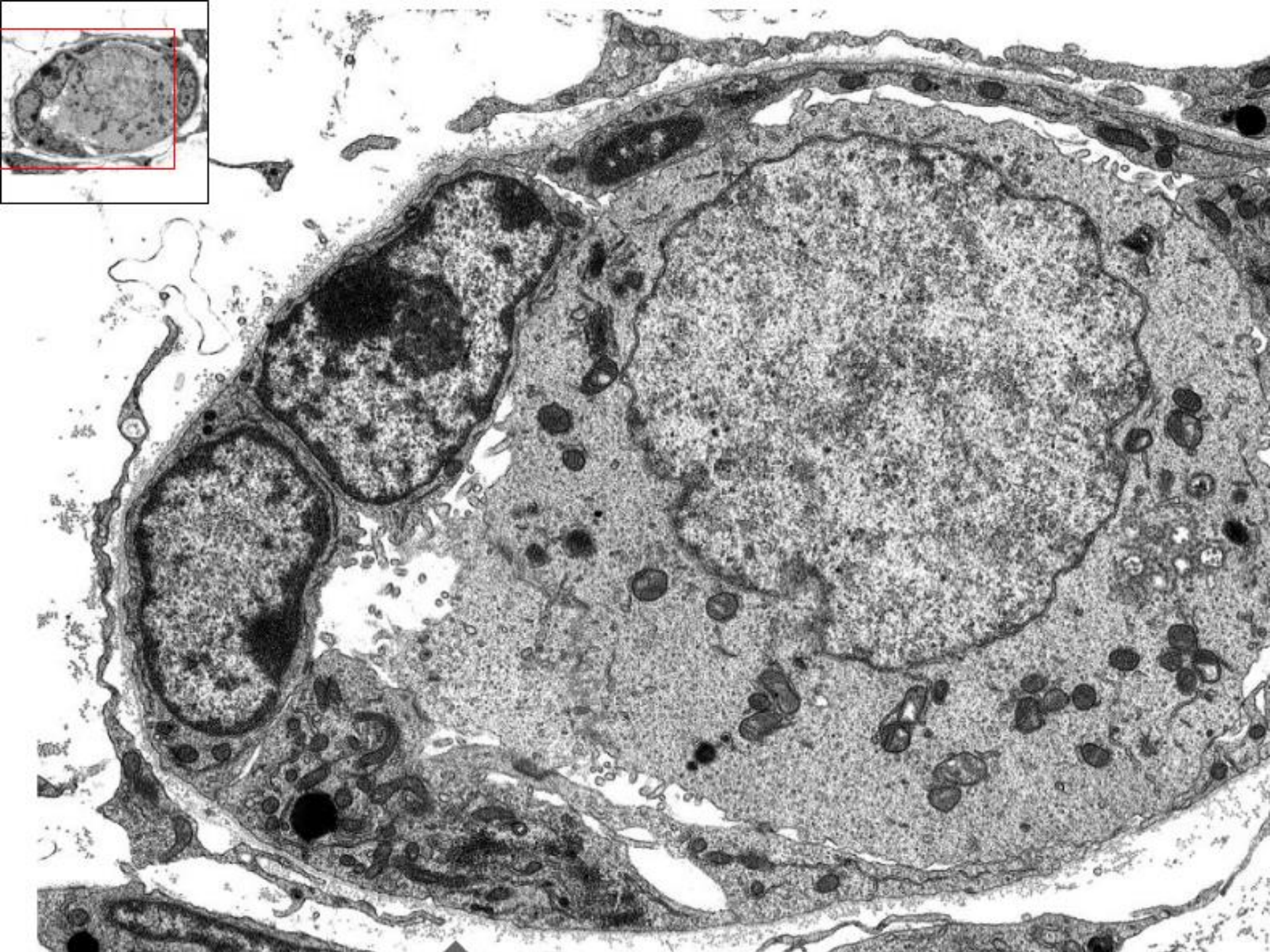

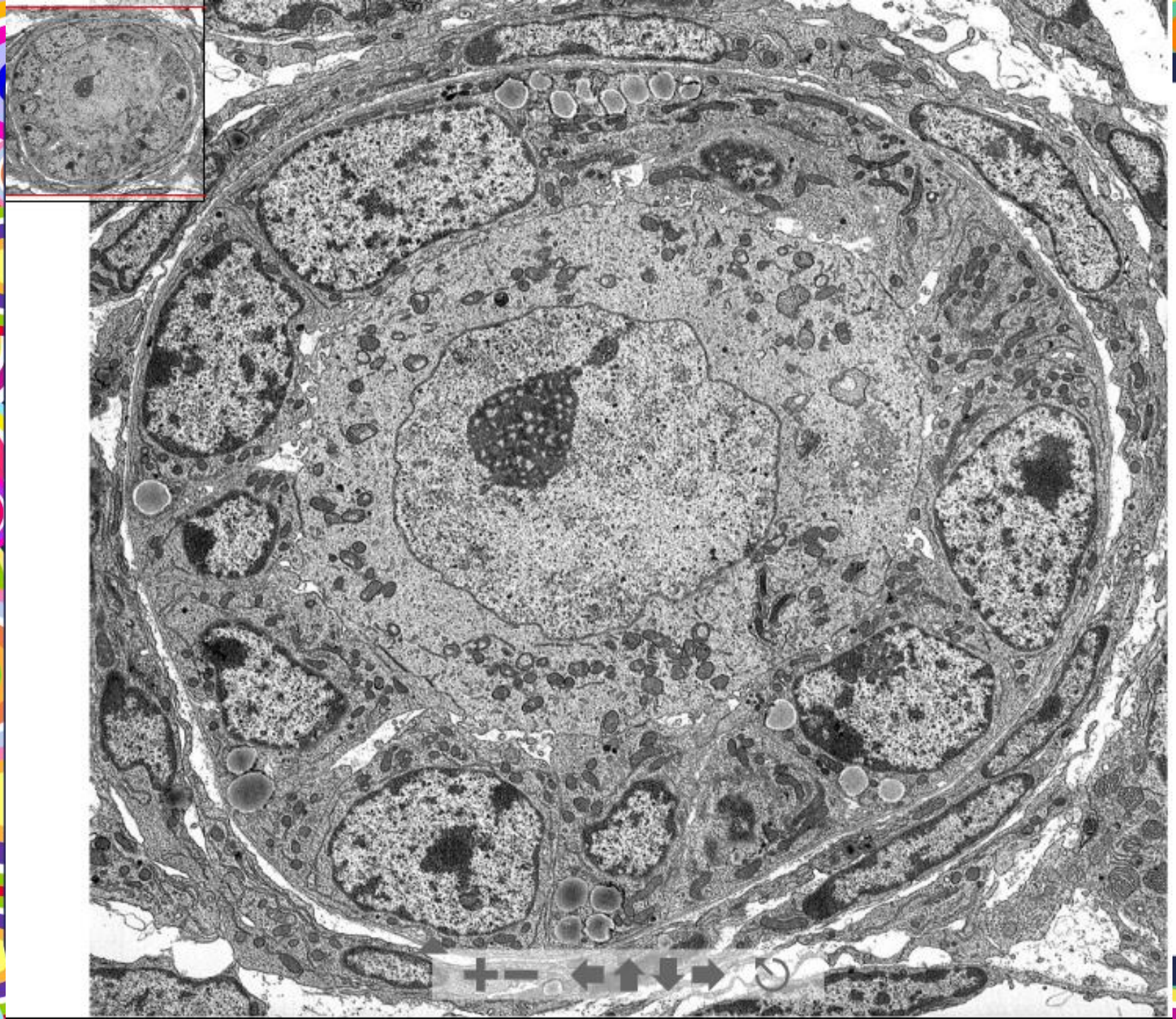

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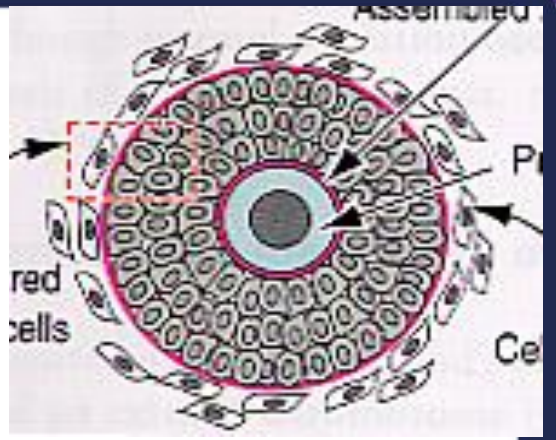
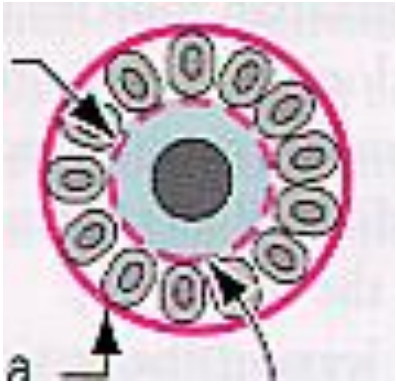
Primary follicle



- Unilaminar / multilaminar
- **Follicular cells**
  - Cuboidal, proliferation
  - Granular appearance --- **Granulosa cells**
- **Zona pellucida**
  - Extracellular proteoglycan layer
- **Theca folliculi**
  - Concentric sheath of interstitial stroma cells



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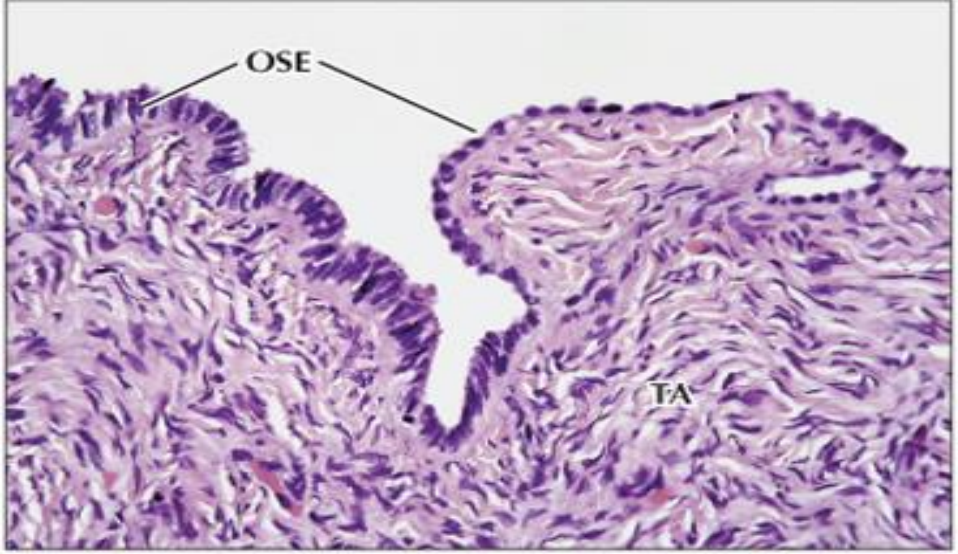
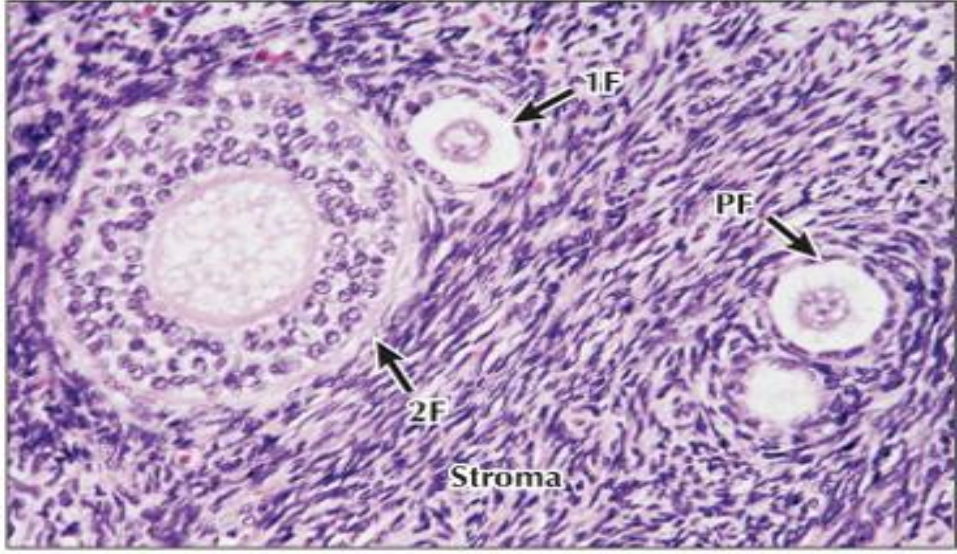
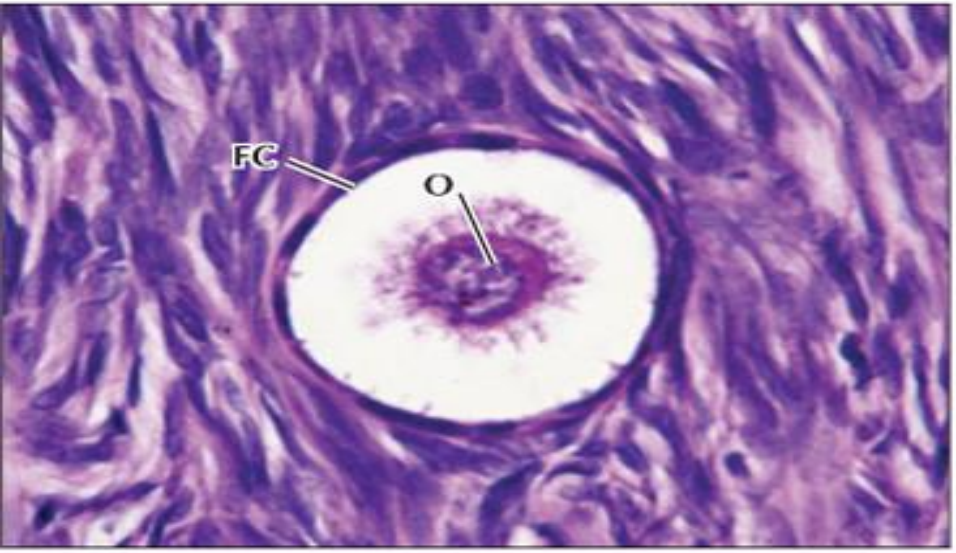


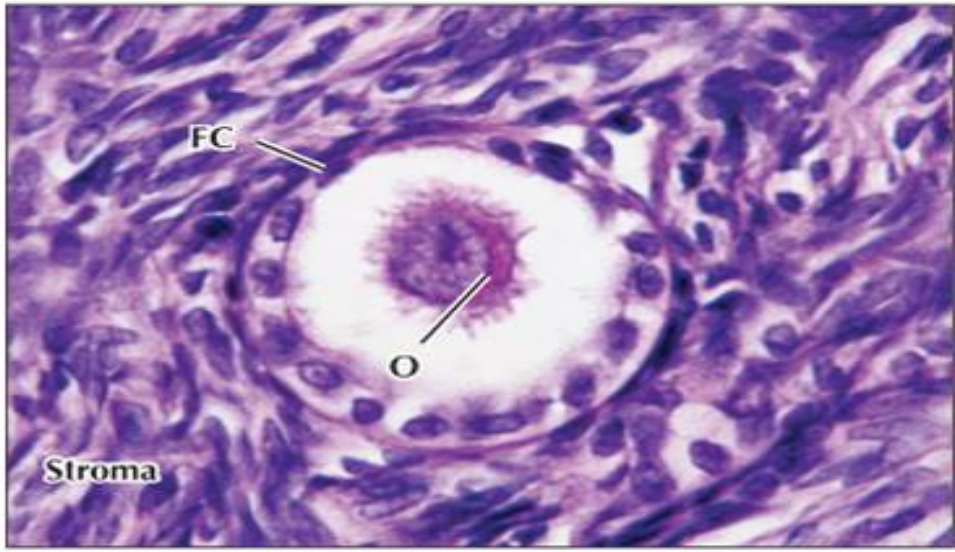
▲ **Light micrograph (LM) of the surface of the ovary.** The ovarian surface epithelium (**OSE**) consists of one layer of cuboidal to columnar cells. A basement membrane separates them from underlying tunica albuginea (**TA**). 390×. *H&E.*



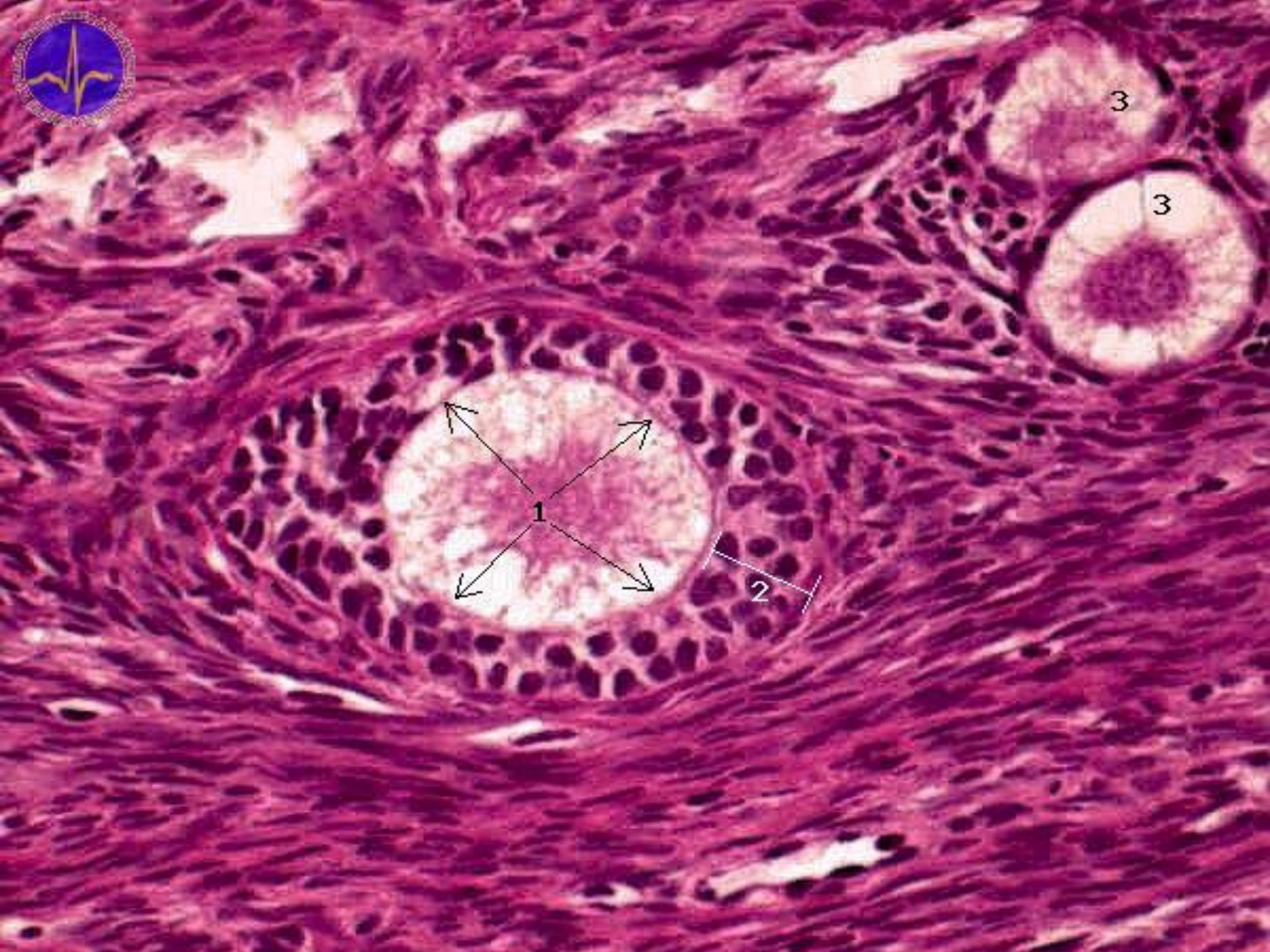
▲ **LM of part of the ovarian cortex.** Markedly cellular connective tissue stroma surrounds primordial (**PF**), primary (**1F**), and secondary (**2F**) ovarian follicles. 295×. *H&E.*



▲ **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.*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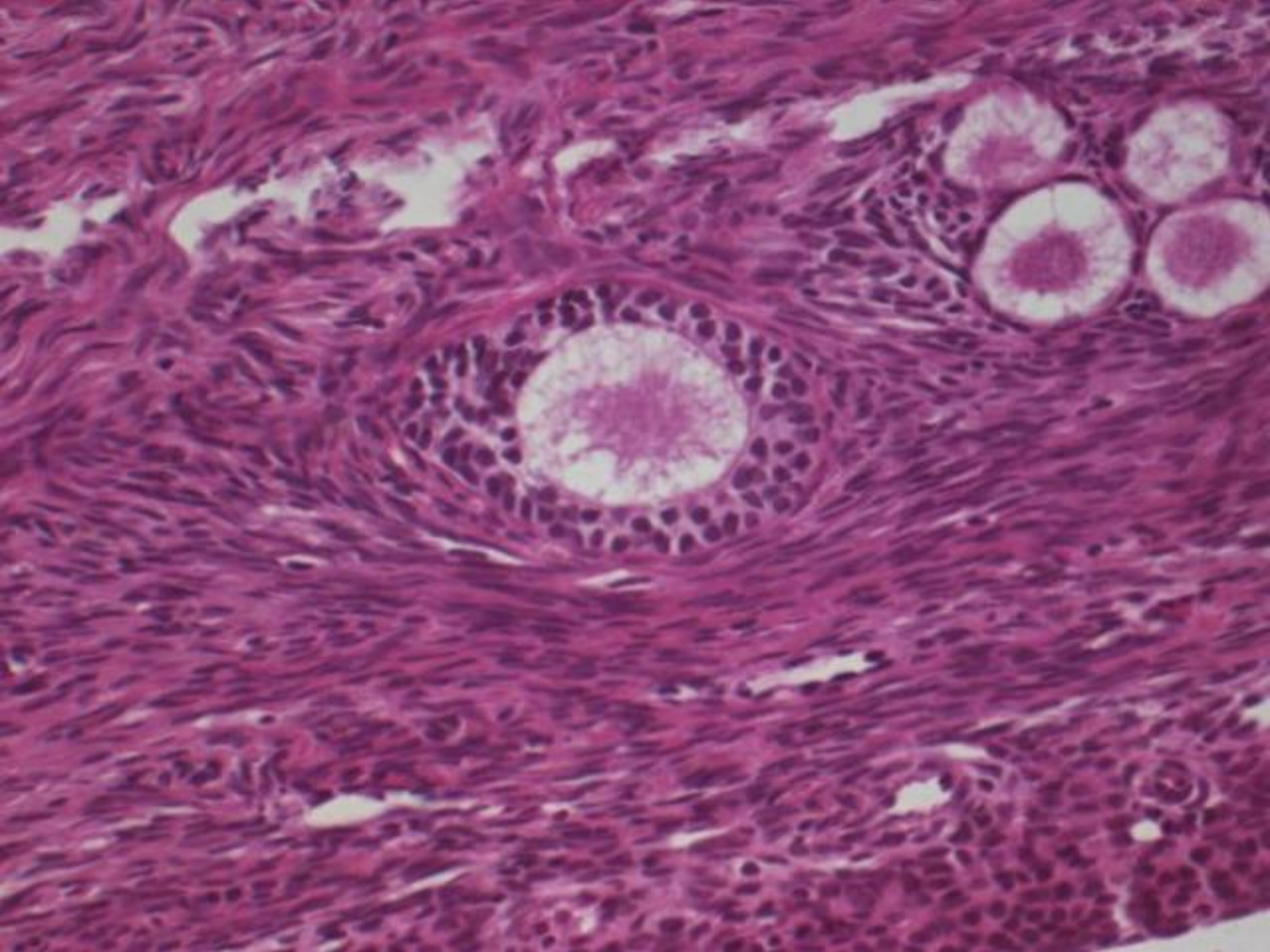

cortex
primary follicle

1 - primary follicle
2 - follicular (granulosa) cells
3 - oocyte
4 - zona pellucida
5 - primordial follicle
8 - interstitial connective tissue
9 - theca

23.03.2023

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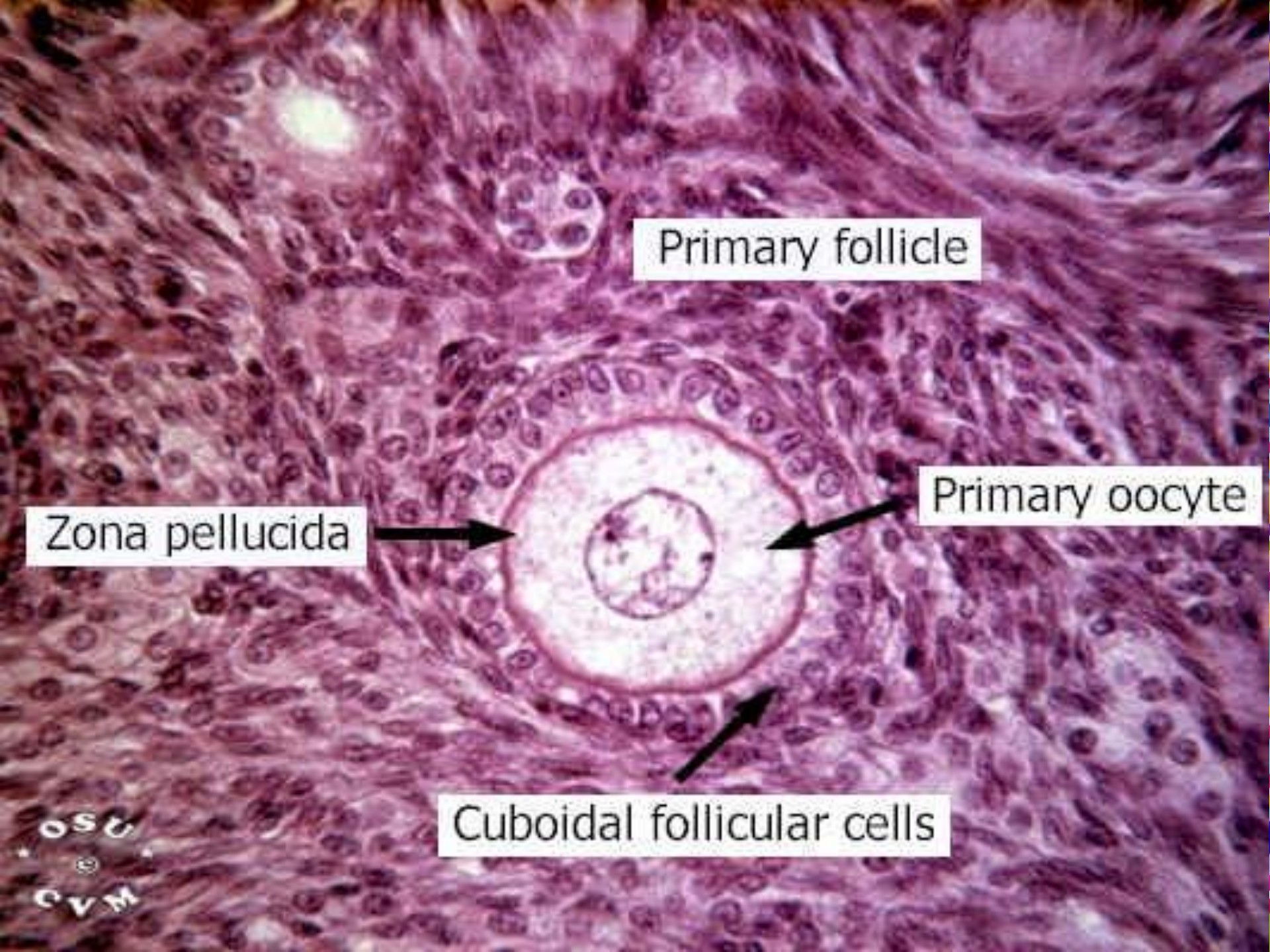
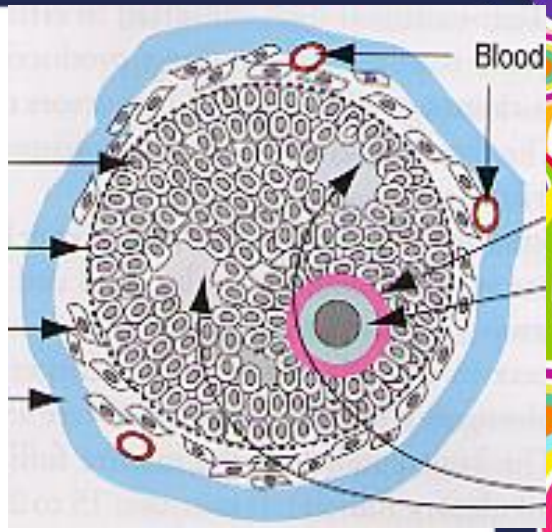

Primary follicle
Zona pellucida
Primary oocyte
Cuboidal follicular cells
OSU
CVM

Secondary follicle



- **Granulosa cells**
  - 8-12 layers
  - Small, fluid-filled spaces
  - Coalesce to single cavity = **antrum folliculi**
  - Filled with viscous fluid = **liquor folliculi**
- **Theca**
  - Theca interna --- **theca cells**
  - Theca externa --- connective tissue and smooth muscle cells

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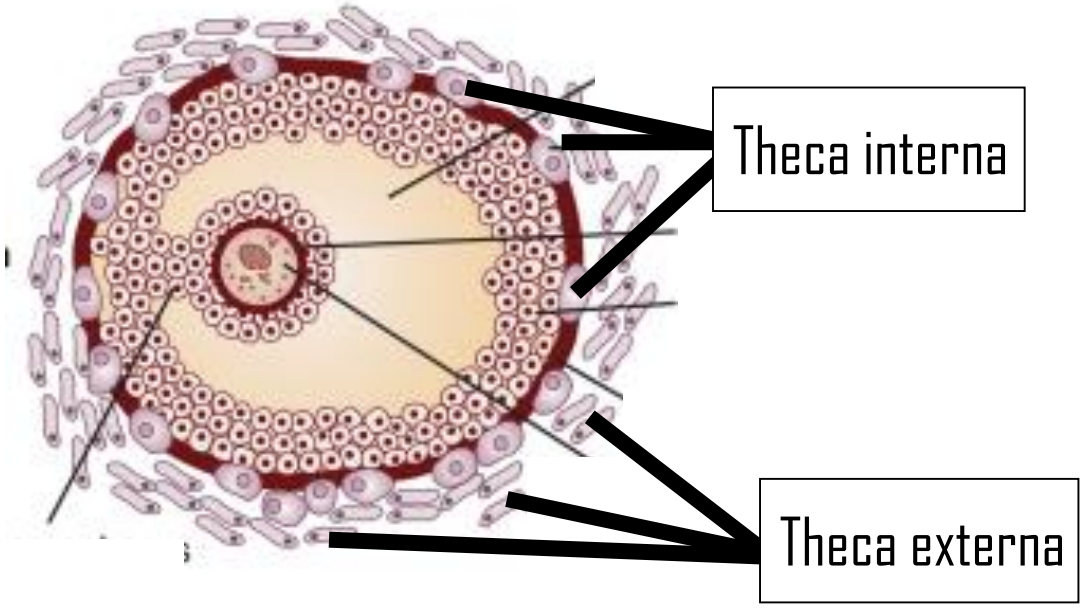
Theca interna and externa

Stromal cells form an outer covering = theca

Theca interna: more vascularized, steroid producing cells

Theca externa: fibroblasts and smooth muscles



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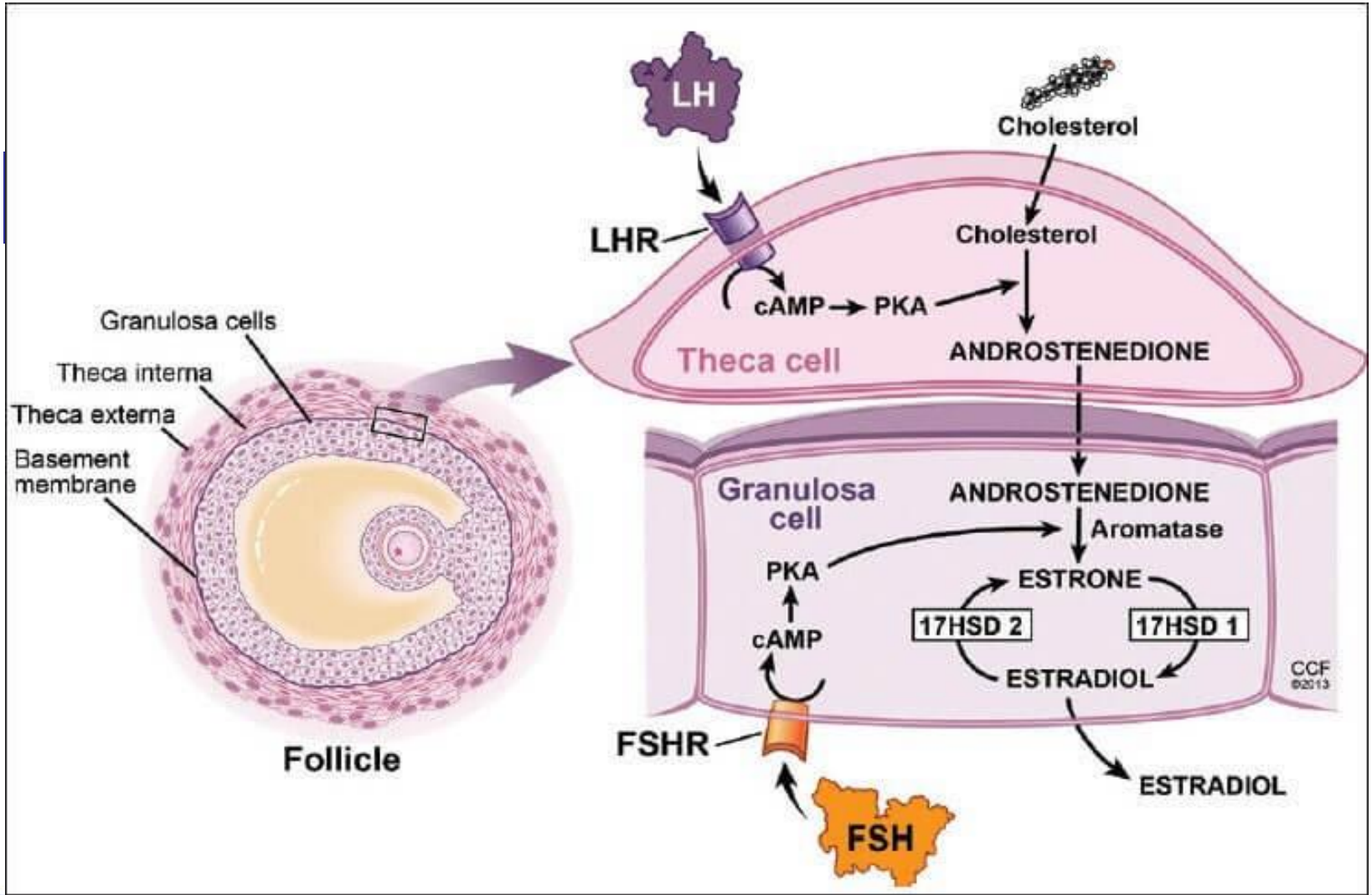
Theca interna and externa



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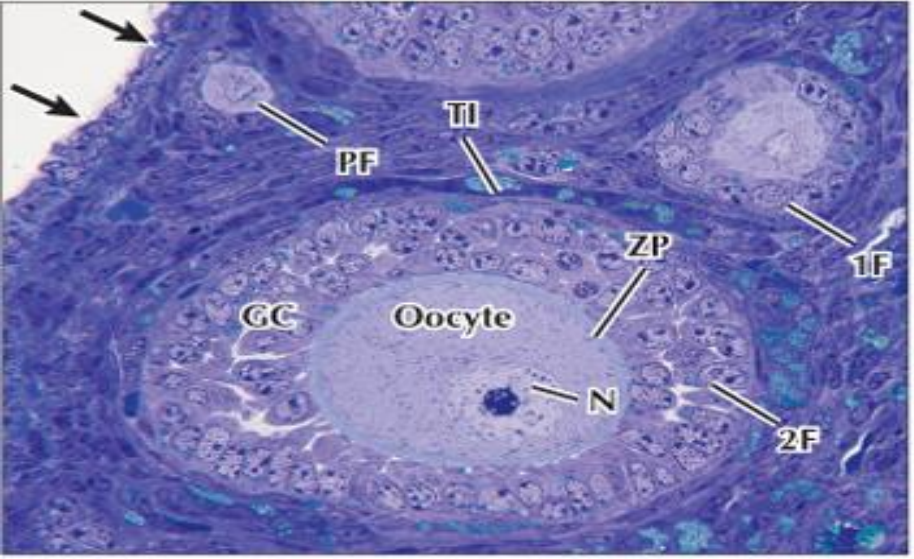
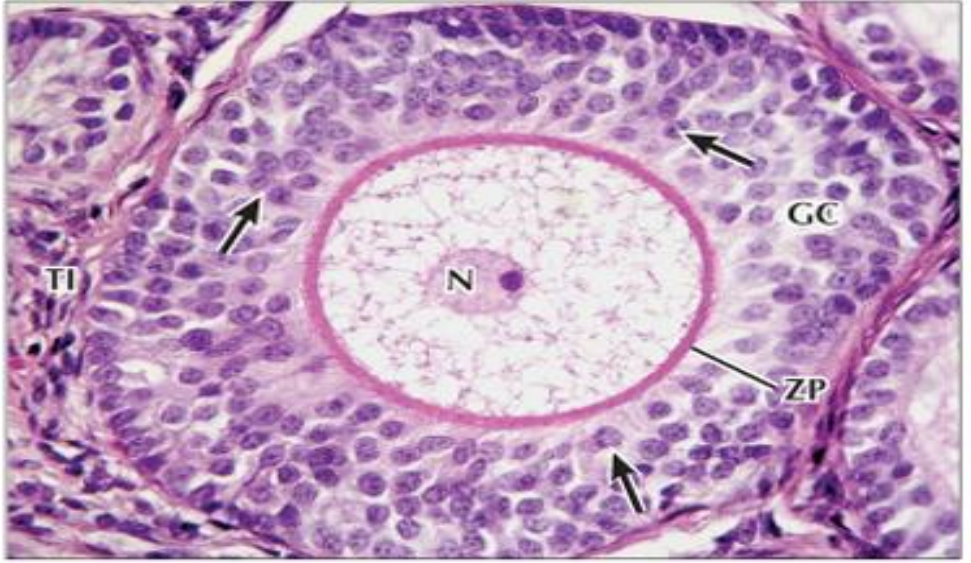
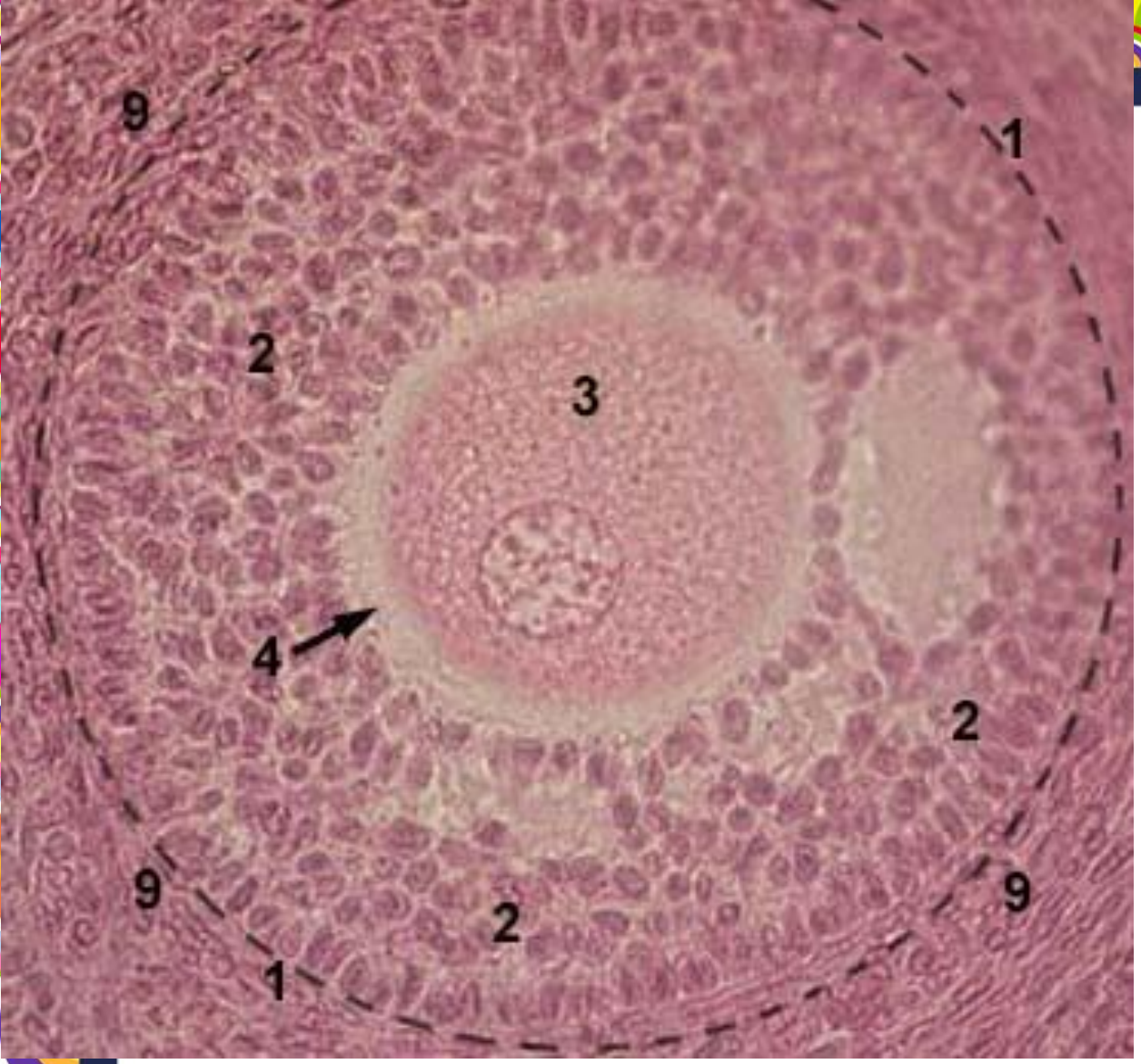


▲ **LM of the cortex of the mouse ovary.** Just under the ovarian surface epithelium (**arrows**) are parts of several follicles at different growth stages, with an oocyte in each follicle. A small primordial follicle (**PF**), a larger primary follicle (**1F**), and a multilaminar secondary follicle (**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×. *Toluidine blue, semithin plastic section.*



▲ **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×. *H&E.*

► **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×. *H&E.*



1 - secondary follicle
2 - follicular (granulosa) cells
3 - oocyte
4 - zona pellucida
5 - primordial follicle
6 - simple cuboidal epithelium which covers the ovary
7 - tunica albuginea
8 - interstitial connective tissue
9 - theca

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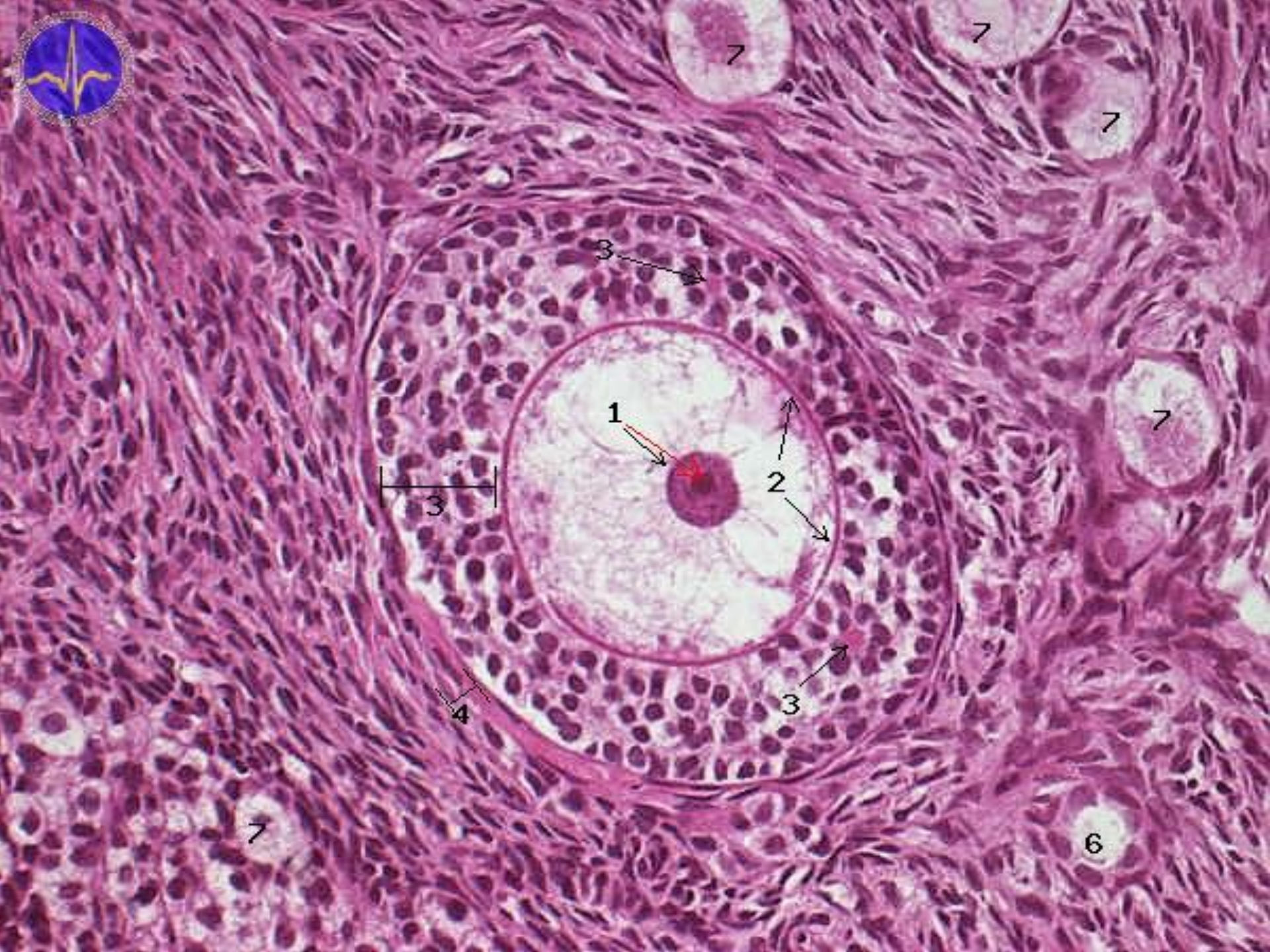
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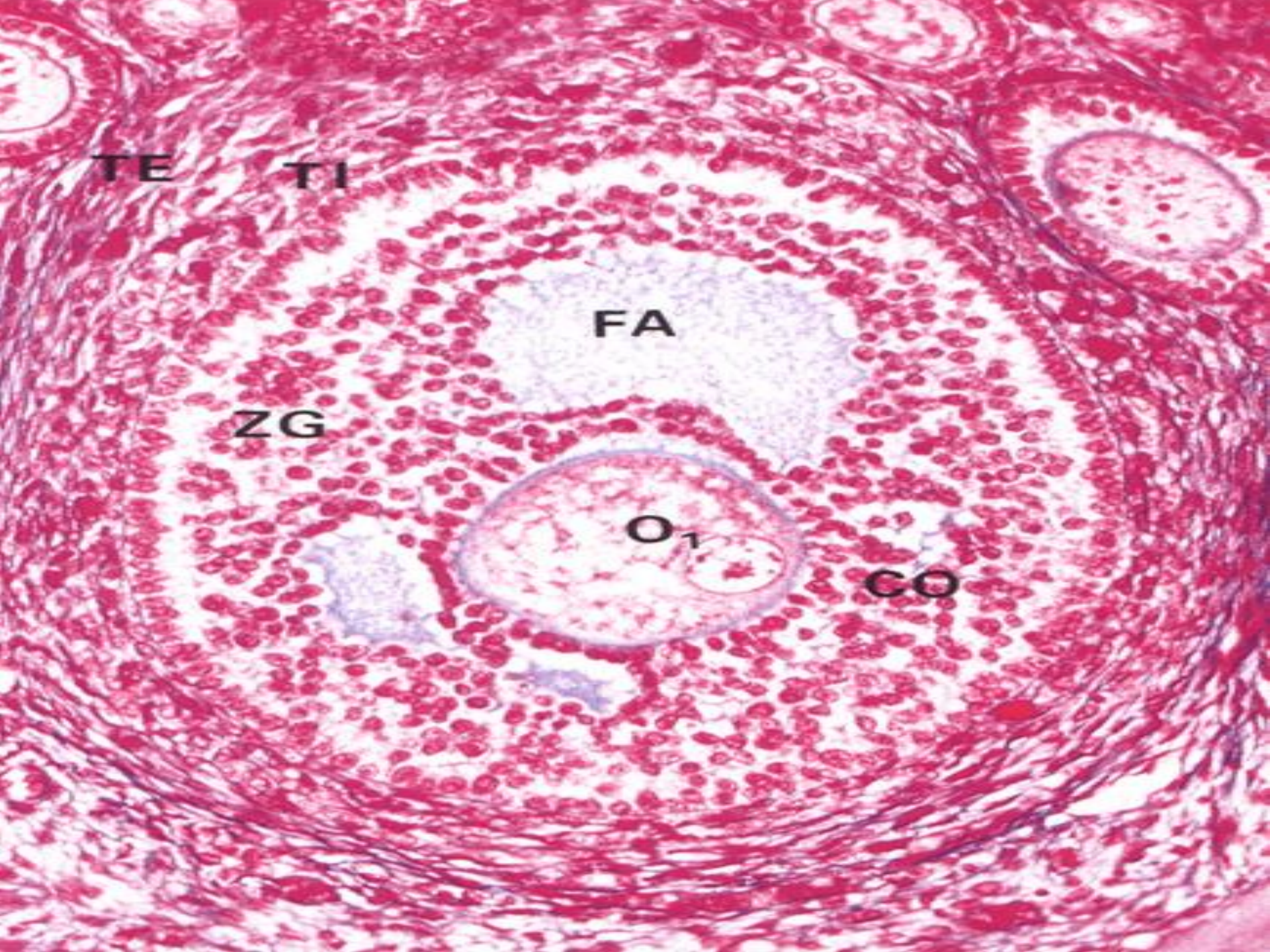
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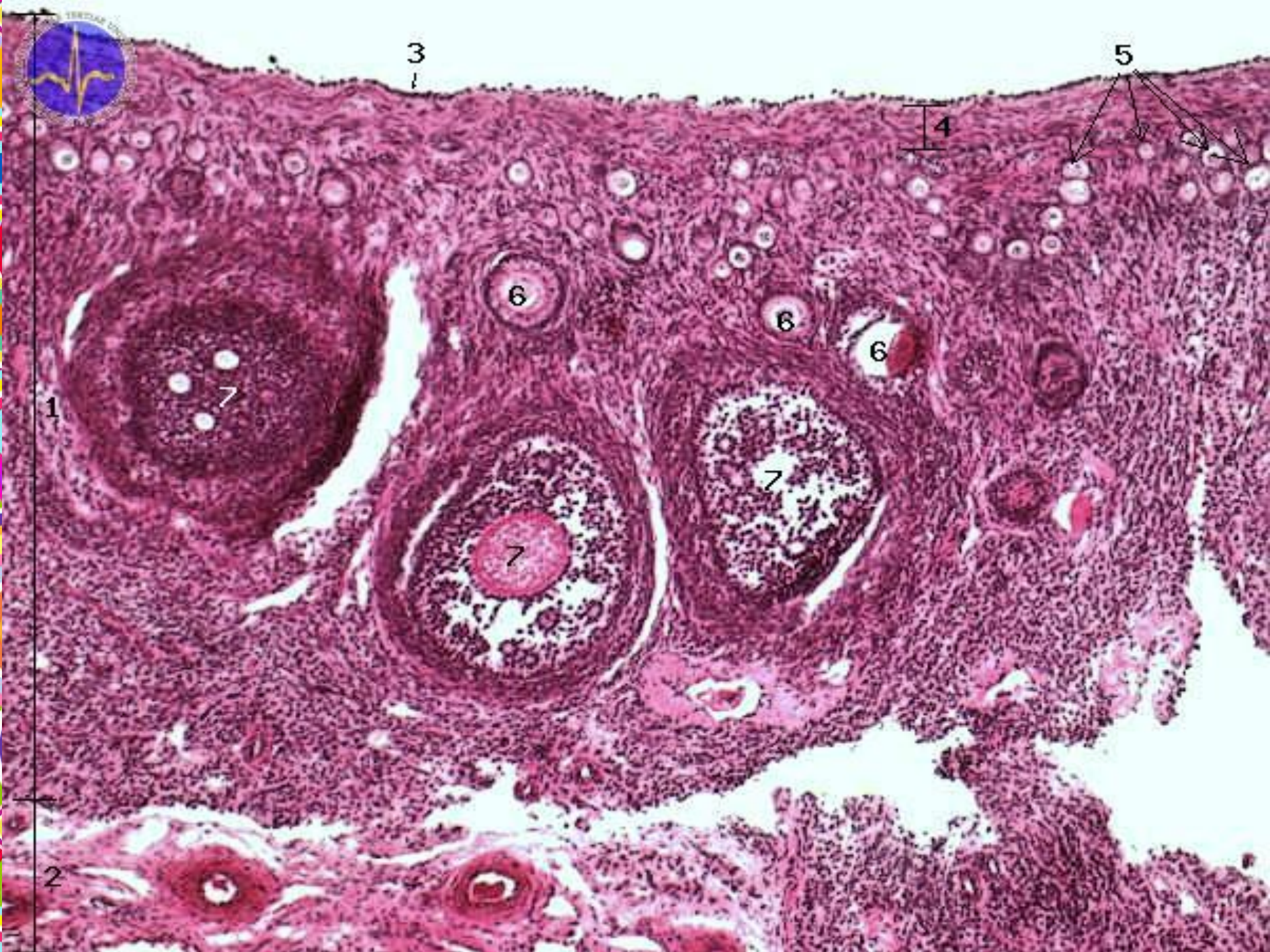
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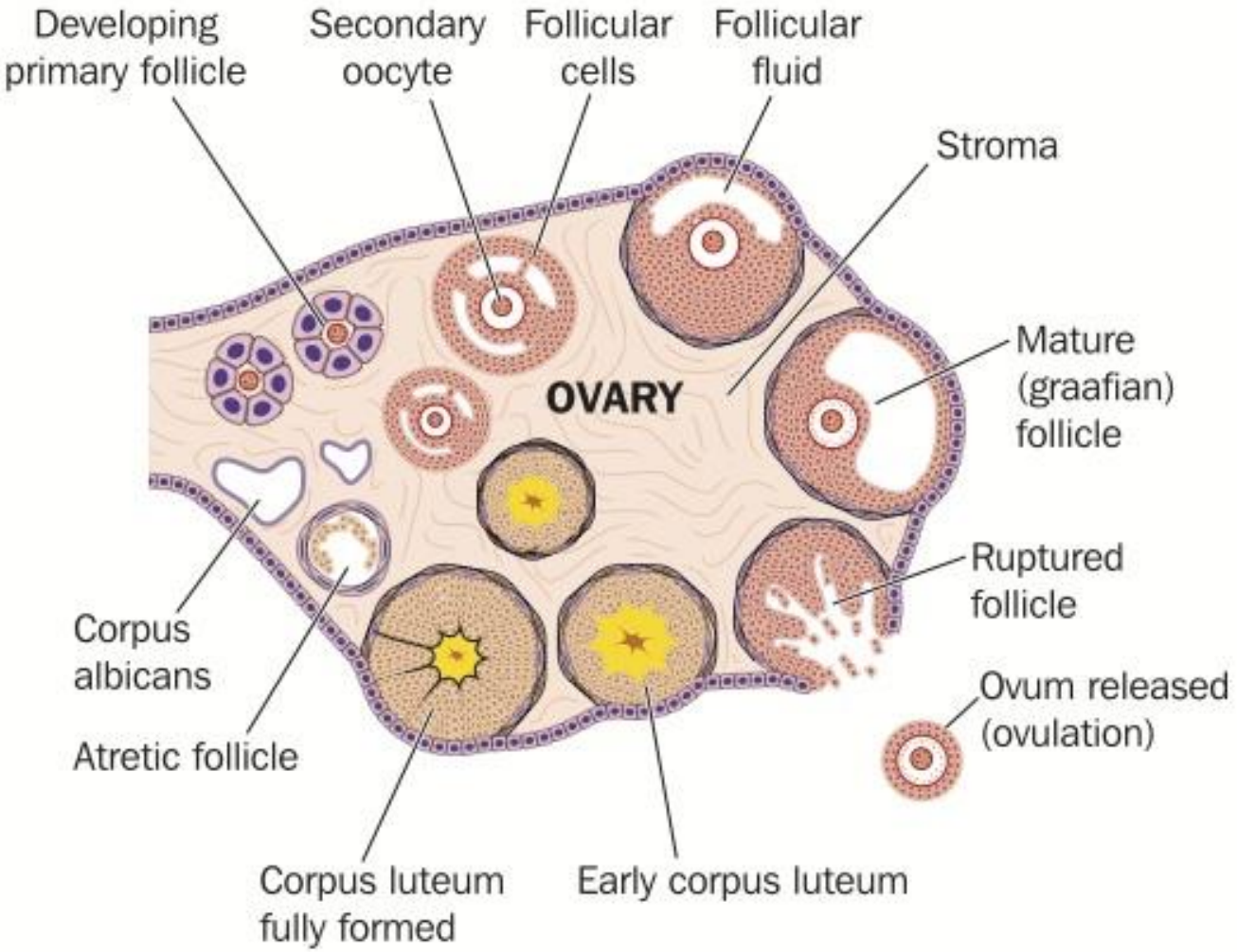
Normal ovary



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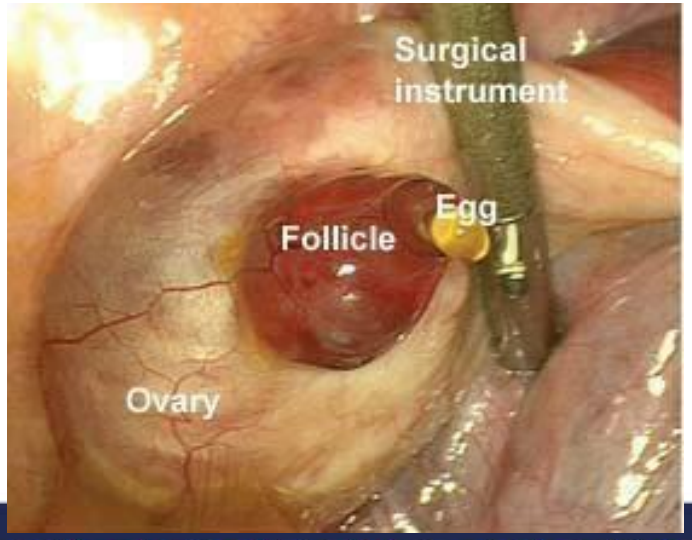
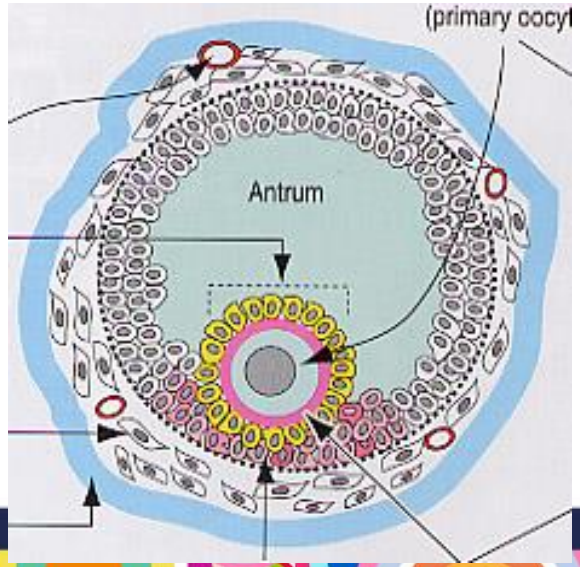
Graafian follicle

- Primary oocyte sits in **cumulus oophorus**

  = local eccentric cluster of granulosa cells

- Granulosa cells
  - Surrounding the oocyte = **corona radiata**
    - **It accompanies the oocyte during ovulation**





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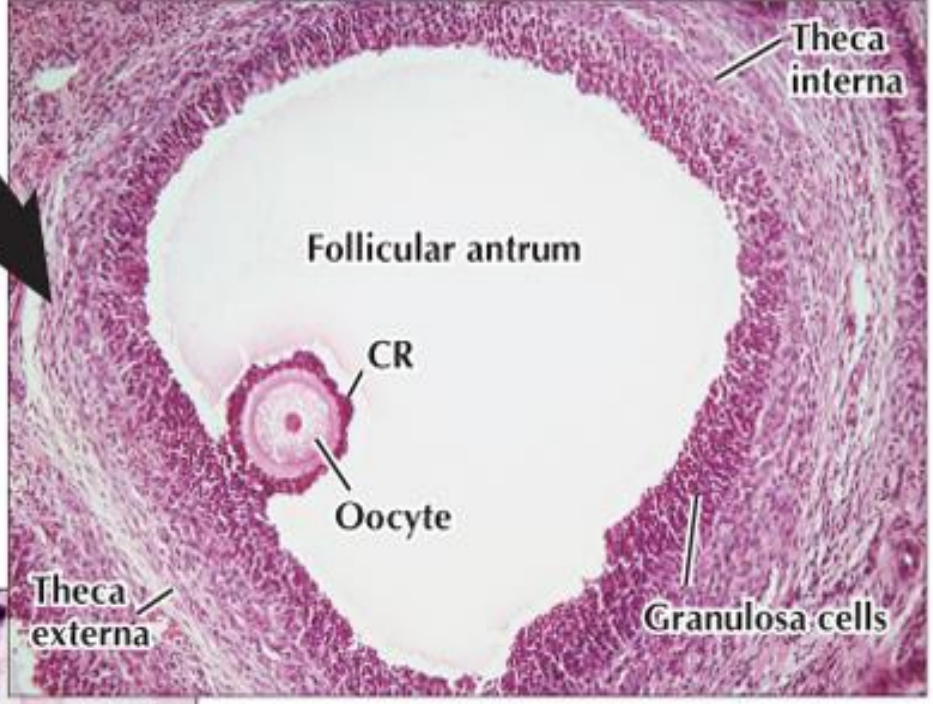
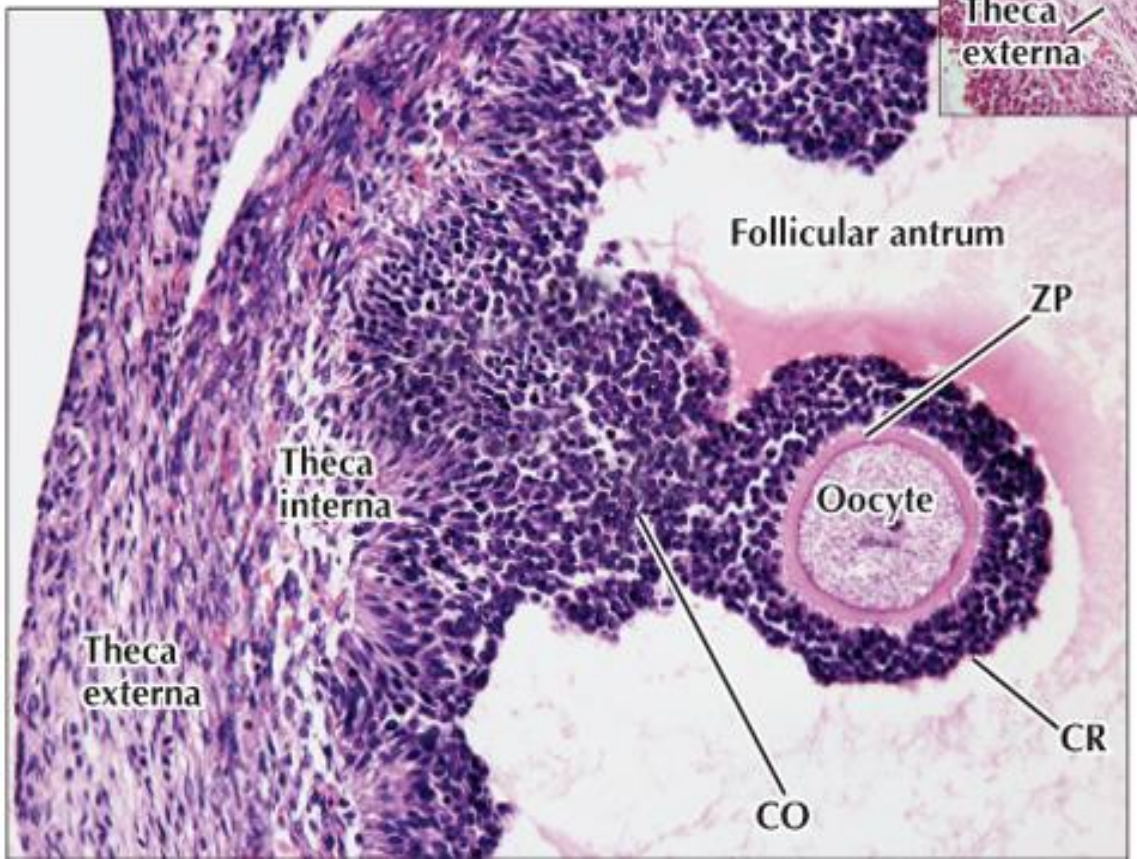
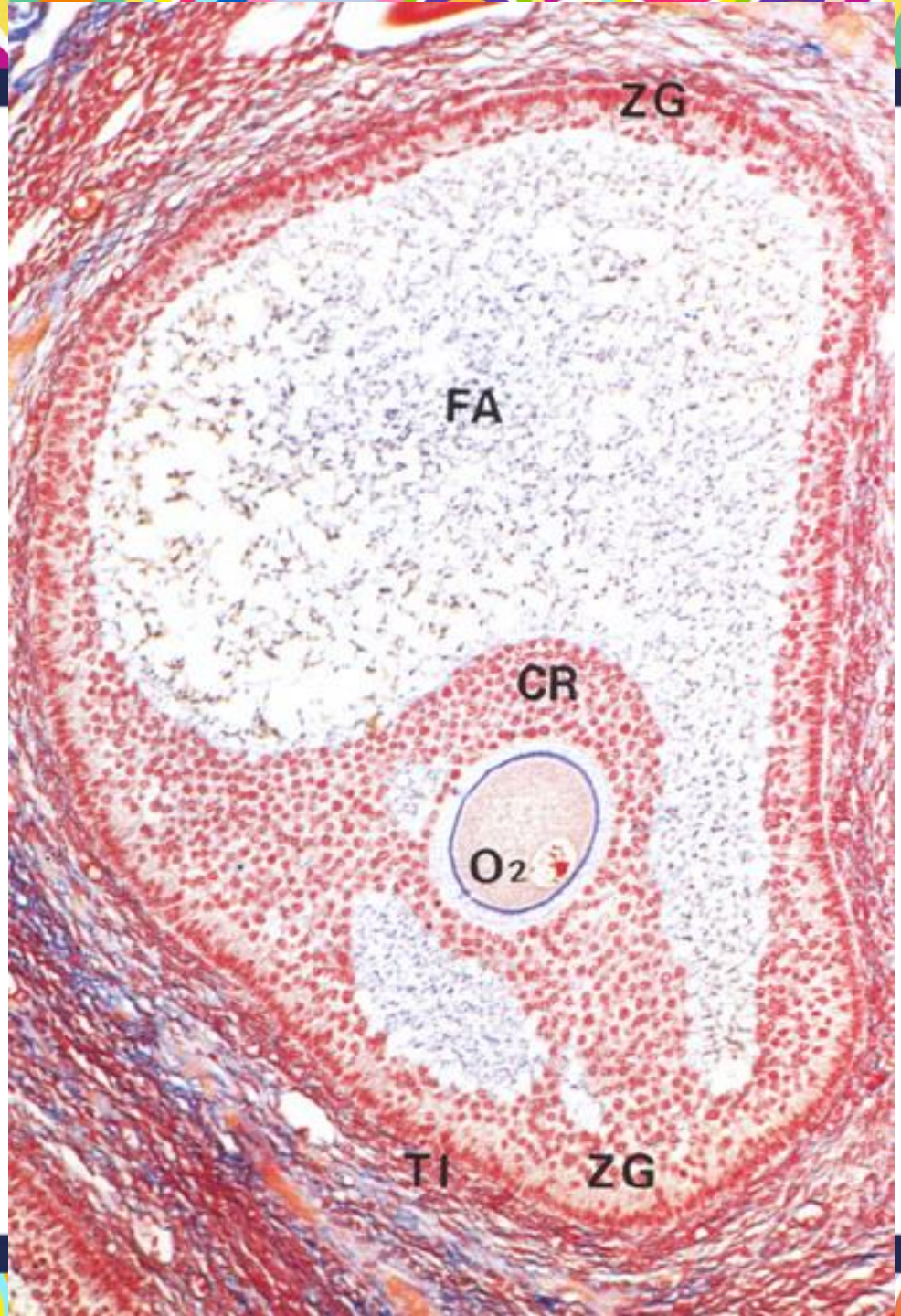
▲ **Low-magnification LM of a mature ovary from a dog.** The outer cortex (**Co**) shows follicles at different maturation stages. The inner medulla (**Me**) contains several blood vessels that enter and emerge from the hilum (**Hi**). 5×. *H&E.*





▲ **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 oophorus (**CO**) is a mass of granulosa cells. The surrounding theca has differentiated into two layers—interna and externa. The antrum contains some flocculent eosinophilic precipitate. 176×. *H&E.*



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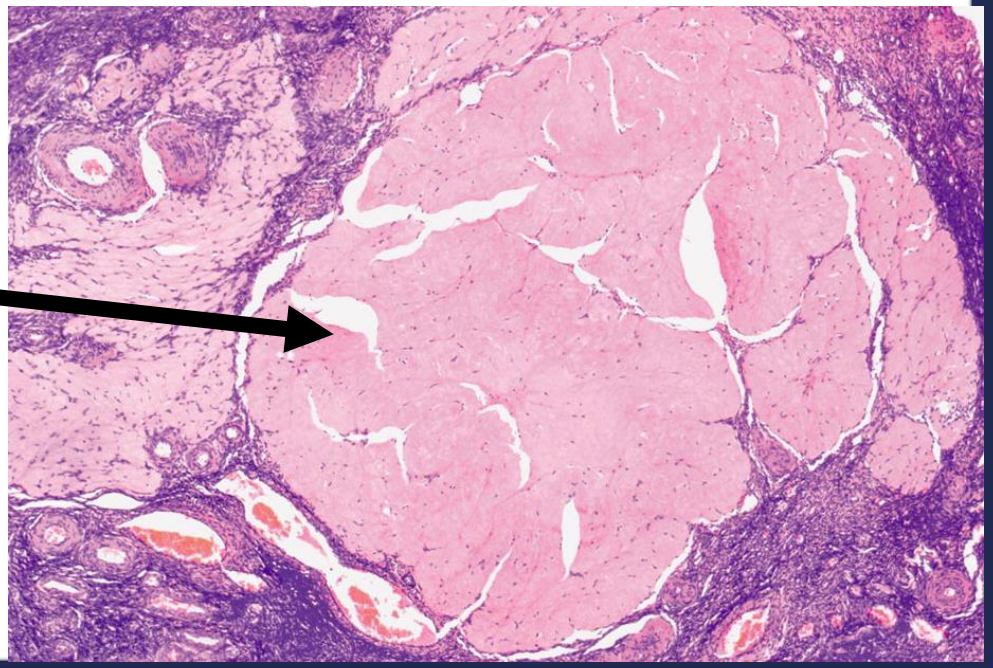
Corpus luteum

- Colapsed, infolded follicular remnant
- Antral space filled with fluid (fibrin) and blood --- coagulation --- **fibrous scar tissue**

Corpus albicans



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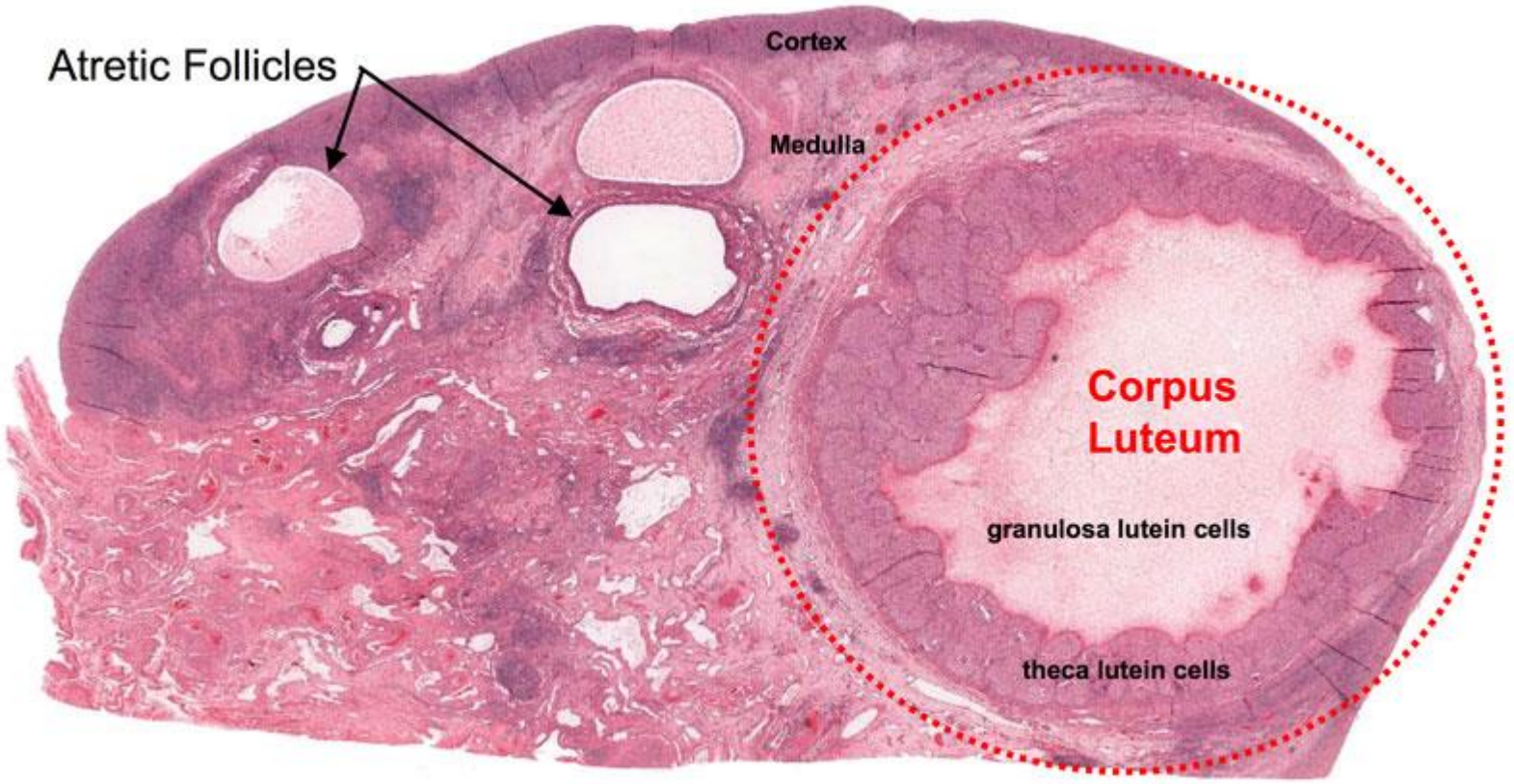
Atretic Follicles
Cortex
Medulla
Corpus Luteum
granulosa lutein cells
theca lutein cells

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2
4
3
1

Corpus luteum

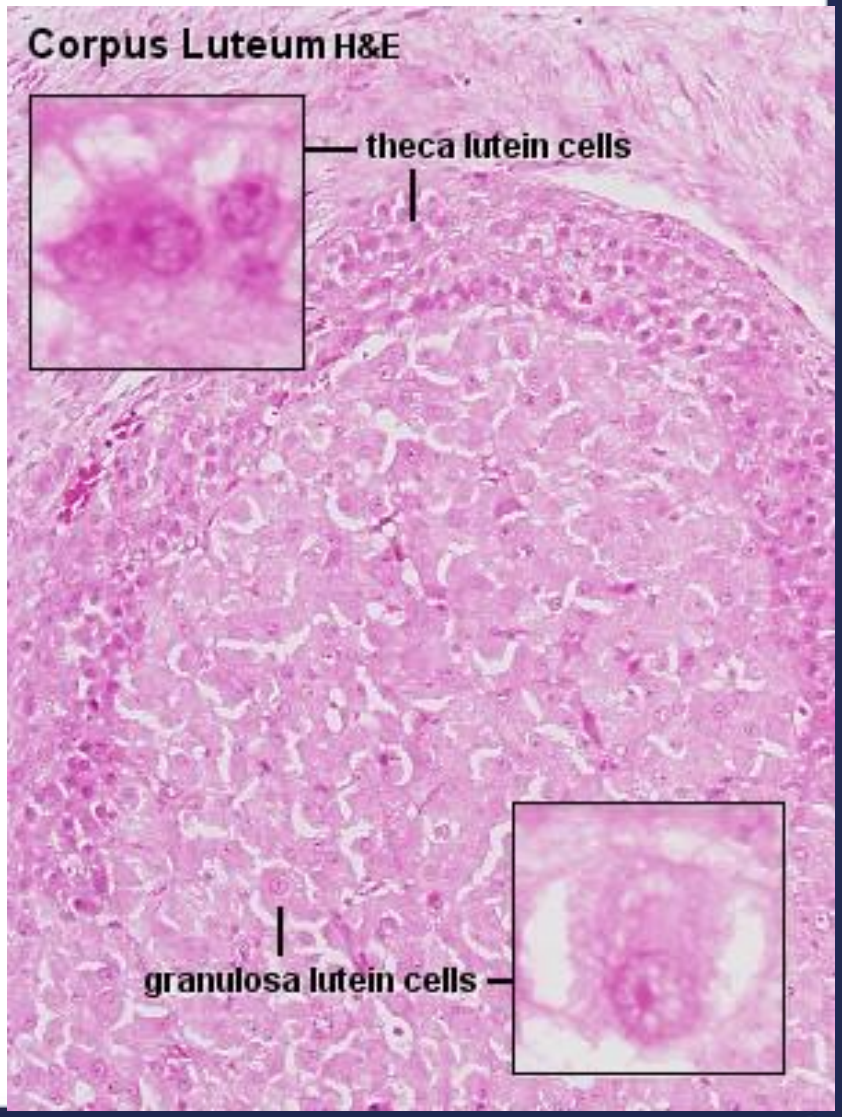
Influence of LH:
Changes of granulosa
and theca interna

1. Granulosa lutein cells

Increase in size
80% parenchyma of CL
Protein secreting cells
(aromatase)

2. Theca lutein cells

Stain more darkly
Steroid producing cells:
progesterone
and androstendione



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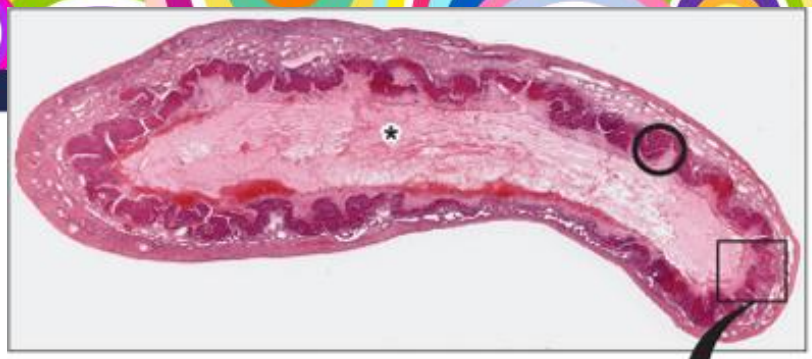
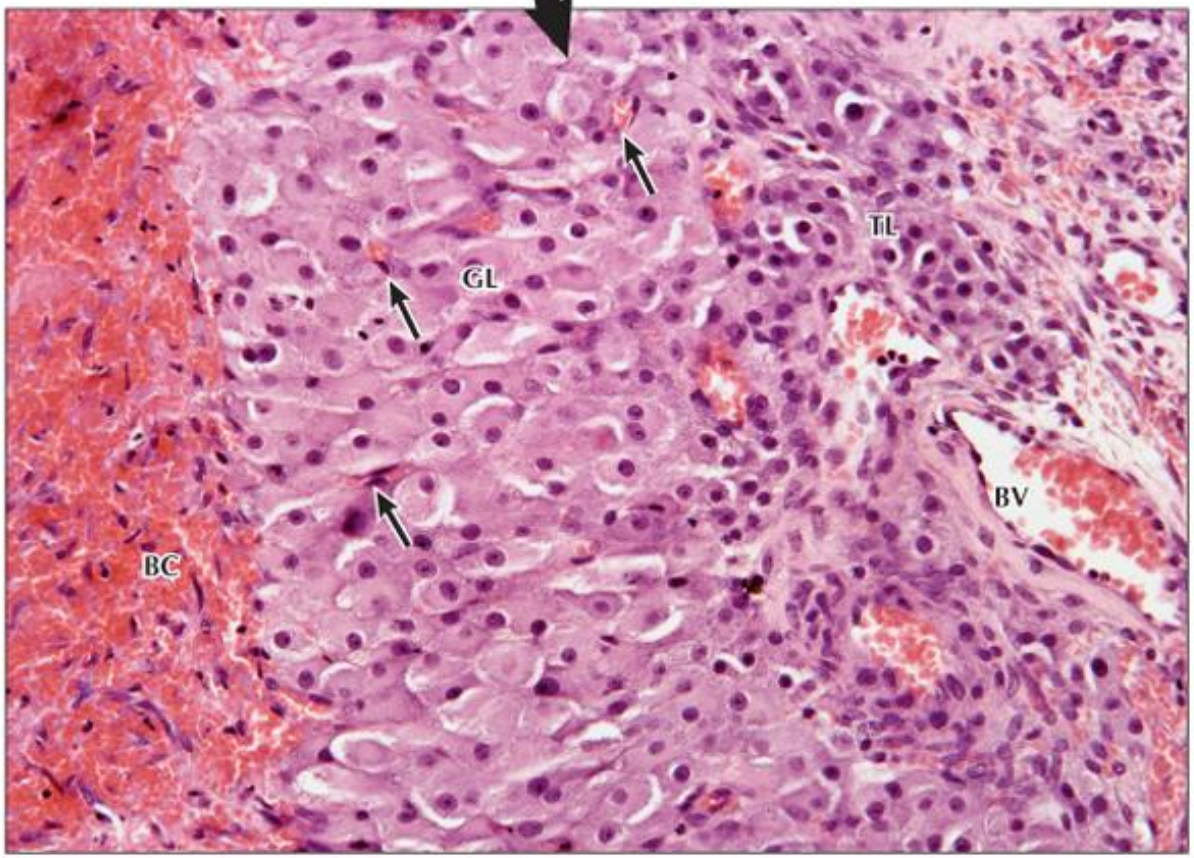


◀ **Low-power LM of the ovary.** The section passes through a corpus luteum. Its outer aspect is highly folded (**circle**) and contains tightly packed granulosa and theca lutein cells, which surround a central cavity (*) filled with coagulated blood and fibrous scar tissue. 6.5×. *H&E.*



▲ **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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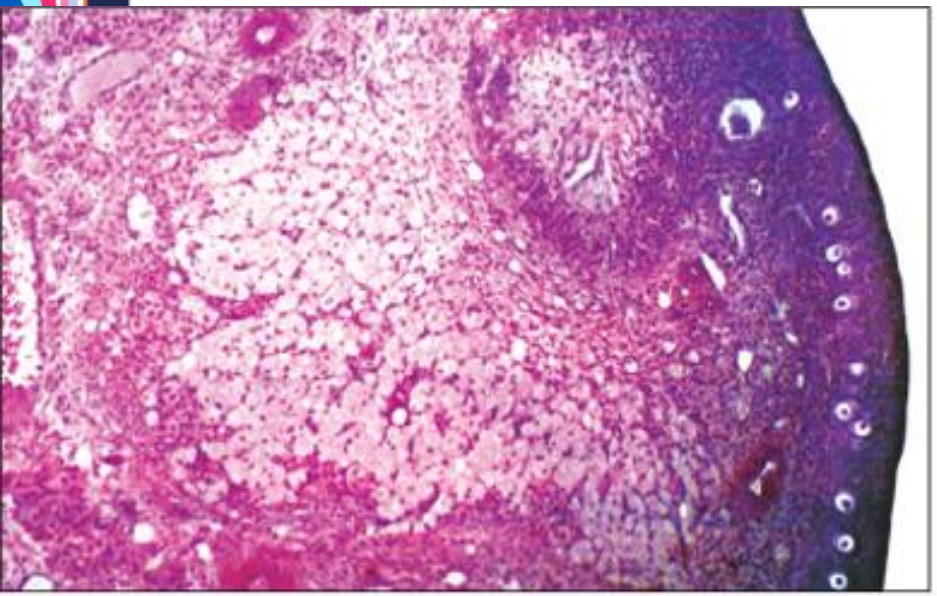

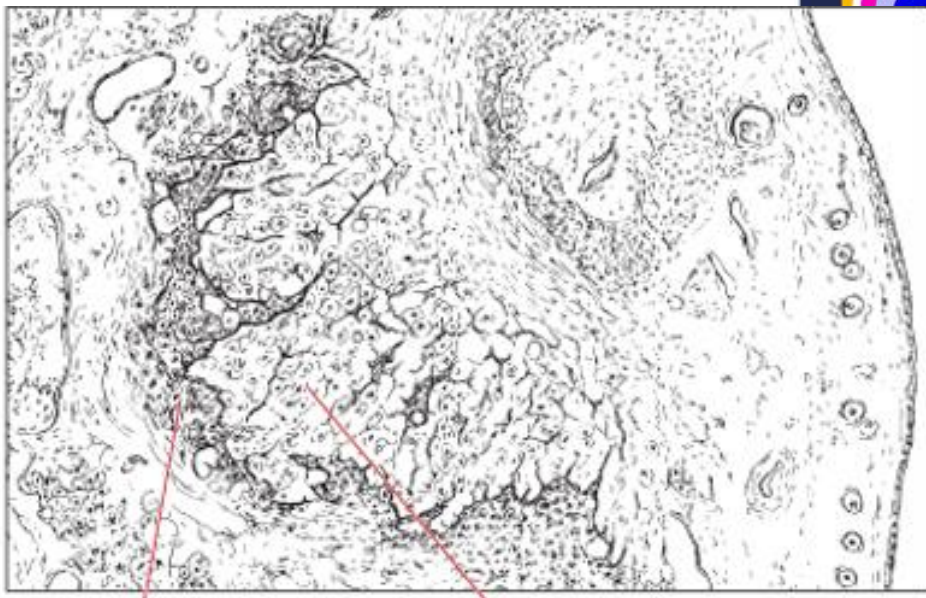

Tallitsch: Histology: An Identification Manual.
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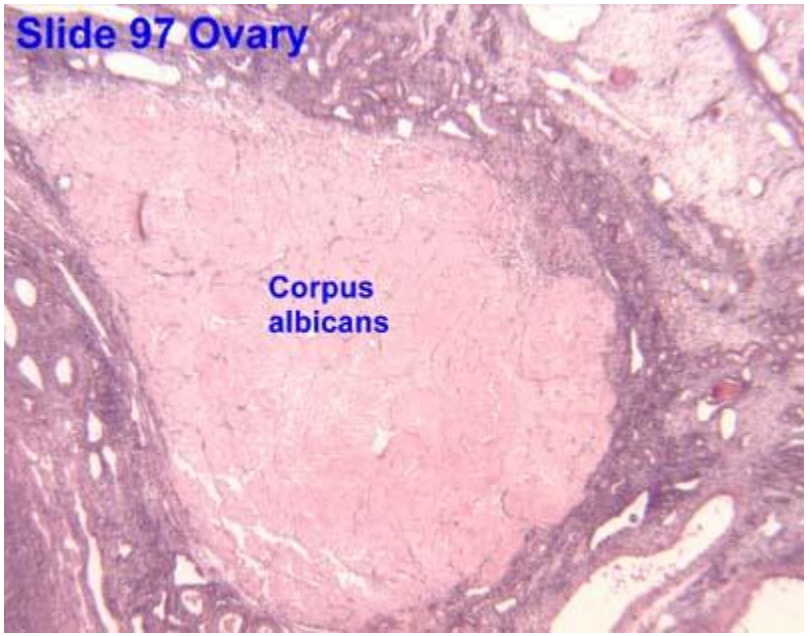
Corpus luteum menstruationis

- Stops producing progesteron after 10-12 days
- Form white scar = **corpus albicans** (white body)



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Corpus luteum graviditatis

- If pragnancy occurs
- Production of progesteron 8 weeks
  - Then placenta becomes major source
  - Under the influence of hCG

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Ovarian cycle

- **Follicular phase** (day 1-13)
  - Follicular maturation
- **Ovulation** (day 14)
  - Follicle ruptures and releases the oocyte and corona radiata
- **Luteal phase** (day 15-28)
  - Corpus luteum

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Fallopian tubes

- 12-15 cm long muscle tubes suspended by mesosalpinx
- Opens into peritoneal cavity (infundibulum)

- Transport, fertilization, initial embryonic development

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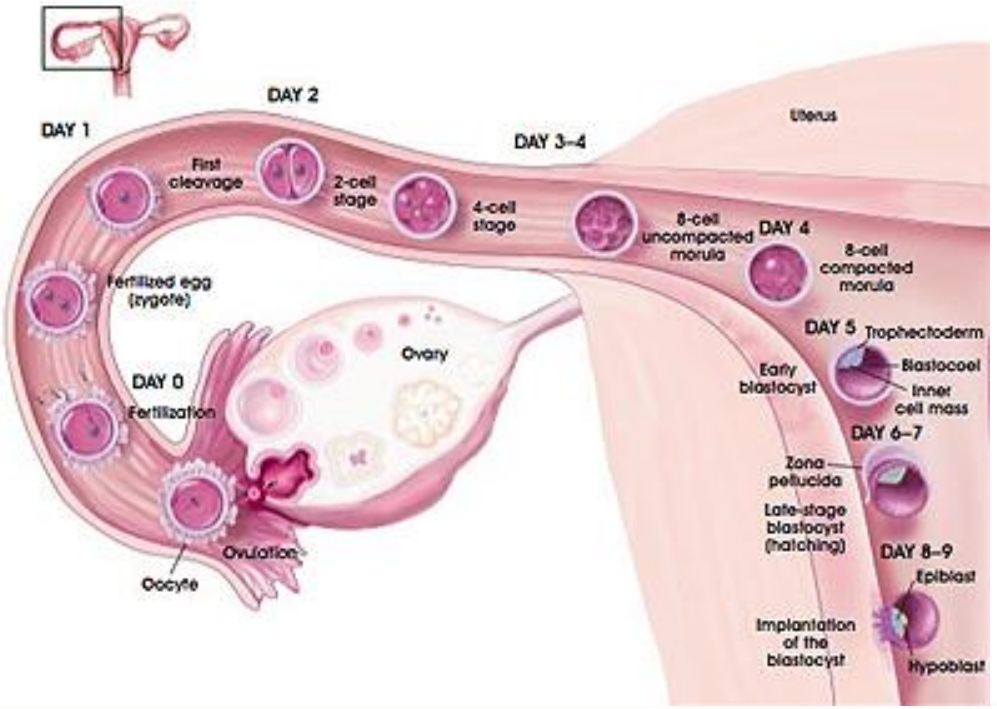
Fallopian tubes

- **Infundibulum**
- **Ampulla**
- **Isthmus**
- **Intramural part**



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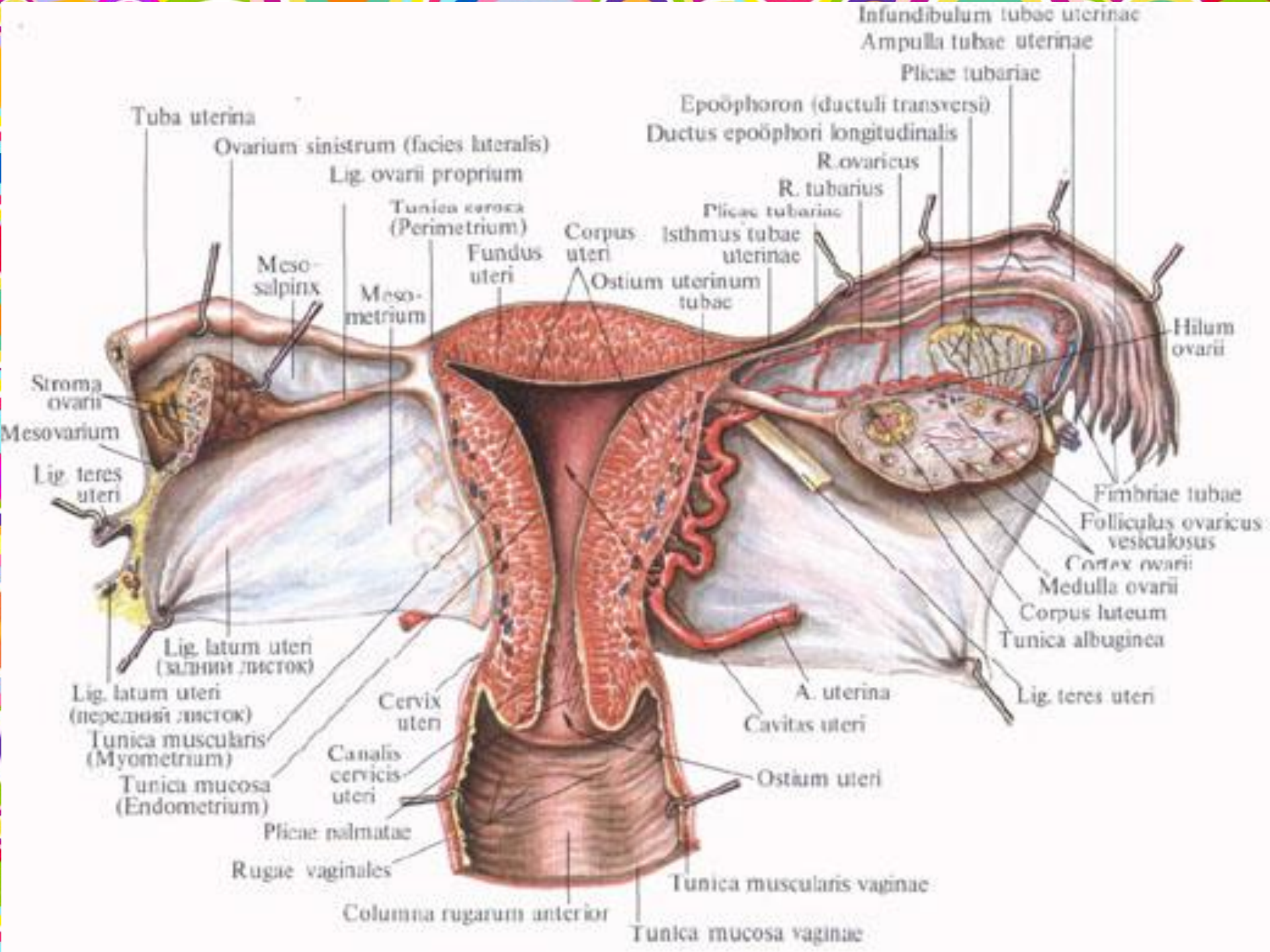
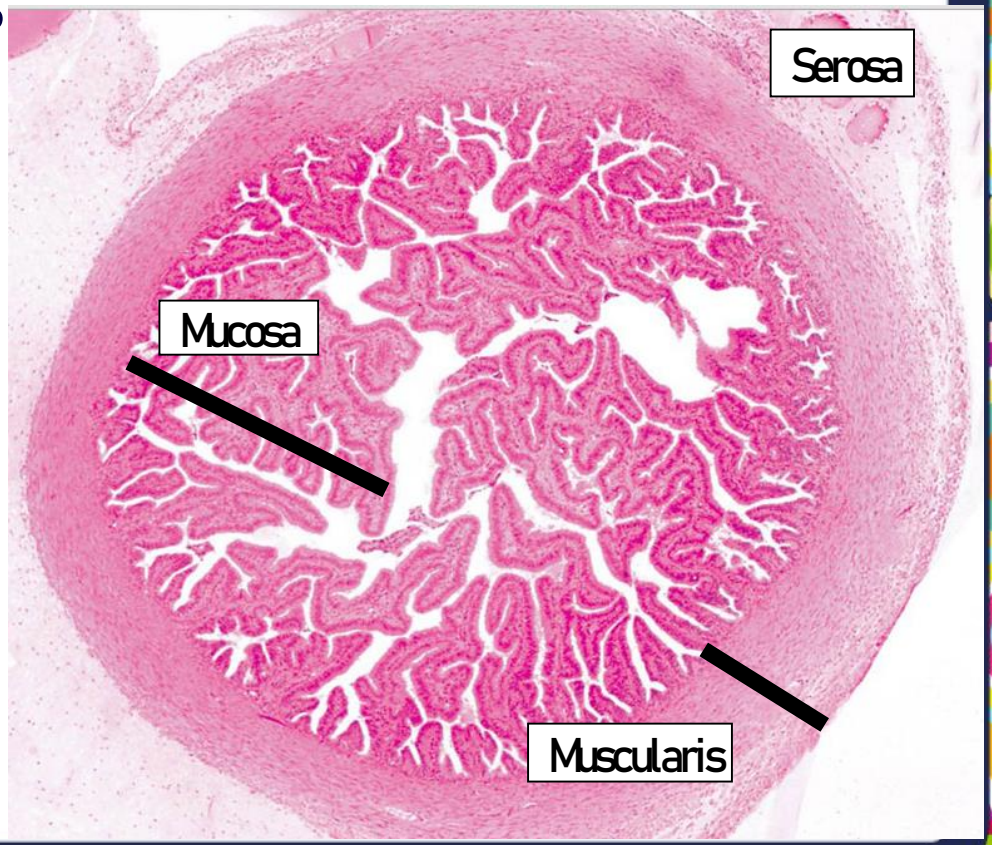

Infundibulum tubae uterinae
Ampulla tubae uterinae
Plicae tubariae
Epoöphoron (ductuli transversi)
Ductus epoöphori longitudinalis
R. ovaricus
R. tubarius
Plicae tubariae
Tuba uterina
Ovarium sinistrum (facies lateralis)
Lig. ovarii proprium
Tunica serosa (Perimetrium)
Corpus uteri
Isthmus tubae uterinae
Fundus uteri
Meso-salpinx
Meso-metrium
Ostium uterinum tubae
Hilum ovarii
Stroma ovarii
Mesovarium
Lig. teres uteri
Fimbriae tubae
Folliculus ovaricus vesiculosus
Cortex ovarii
Medulla ovarii
Corpus luteum
Tunica albuginea
Lig. latum uteri (задний листок)
Lig. latum uteri (передний листок)
A. uterina
Lig. teres uteri
Cervix uteri
Cavitas uteri
Tunica muscularis (Myometrium)
Canalis cervicis uteri
Ostium uteri
Tunica mucosa (Endometrium)
Plicae palmatae
Rugae vaginales
Tunica muscularis vaginae
Columna rugarum anterior
Tunica mucosa vaginae

Fallopian tubes

- **Tunica mucosa**
- **Tunica muscularis**
- **Tela subserosa**
- **Tunica serosa**



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Tunica mucosa

- Longitudinal **folds** increase surface area
  - Decrease toward the uterus
- **Simple columnar epithelium**
  - **Ciliated cells**
    - Ciliary motility and oocyte transport
  - **Secretory cells** (peg cells)
    - GP to provide nutrients to oocyte

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Tunica muscularis

- Two indistinct layers of smooth muscle

- Inner **circular**
- Outer **longitudinal**

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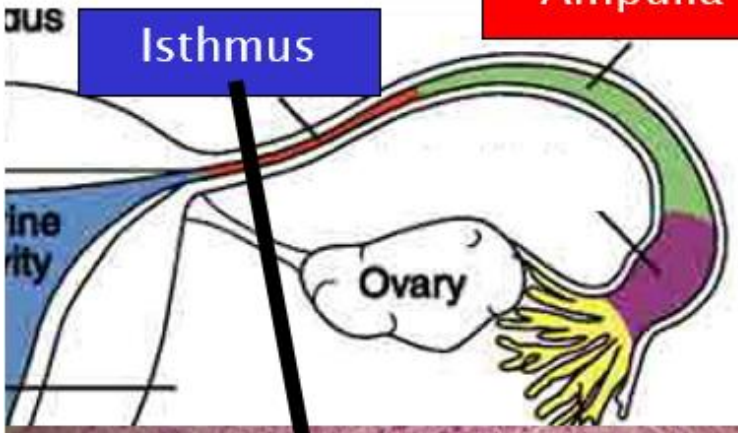
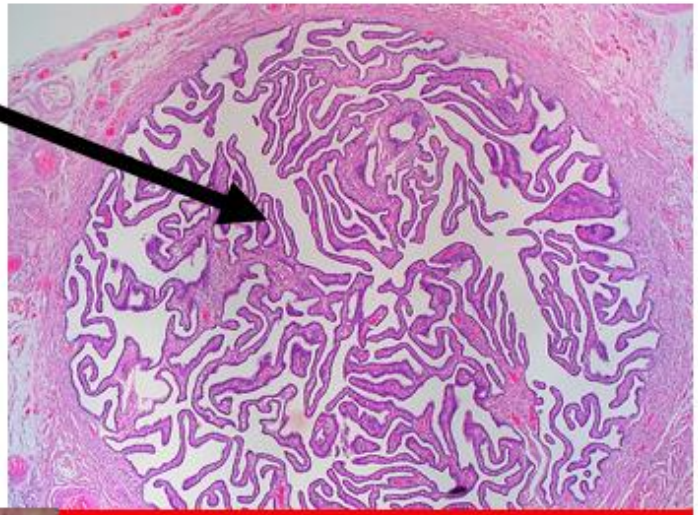
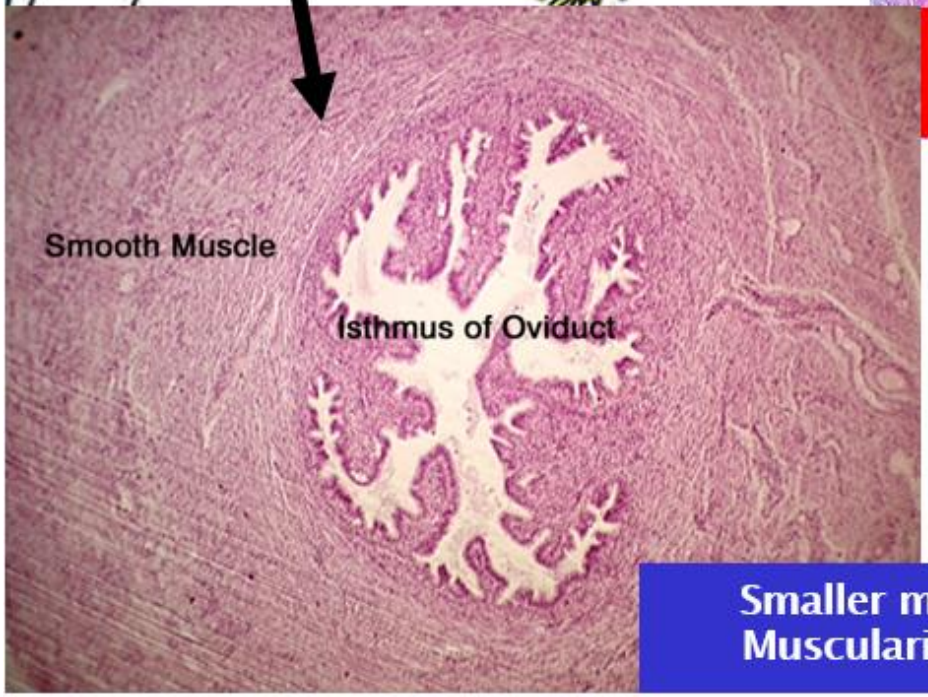
Ampulla

Isthmus





Prominent folds
Resemble a labyrinth



Smaller mucosal folds
Muscularis prominent

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	Folds	Ciliated cells	Secretory cells	Smooth muscle
Infundibulum	+++	+++	+	+
Ampulla	+++	+++	++	++
Isthmus	++	++	+++	+++
Pars intramuralis	+	+	+++	+++

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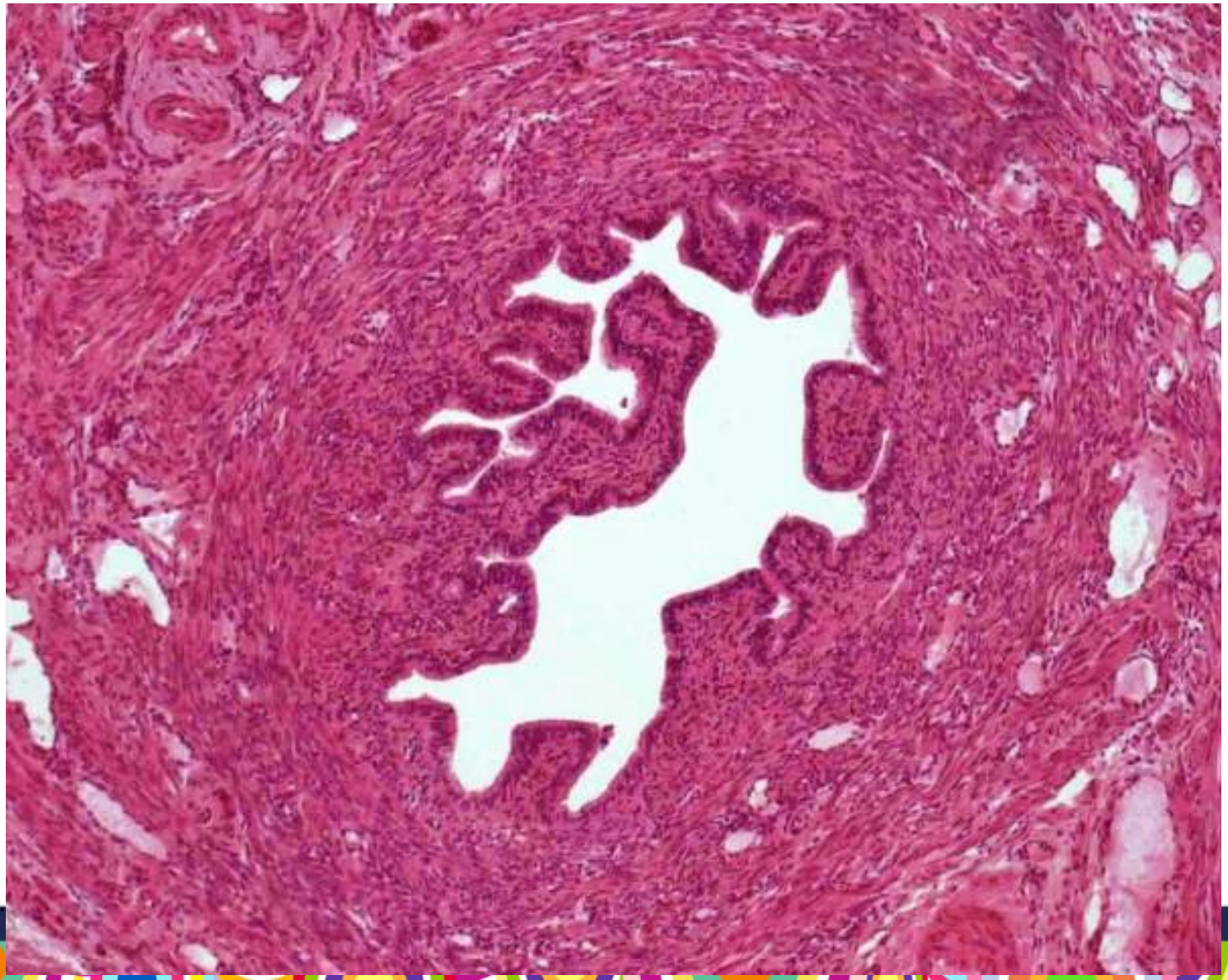
Isthmus tubae uterinae



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1
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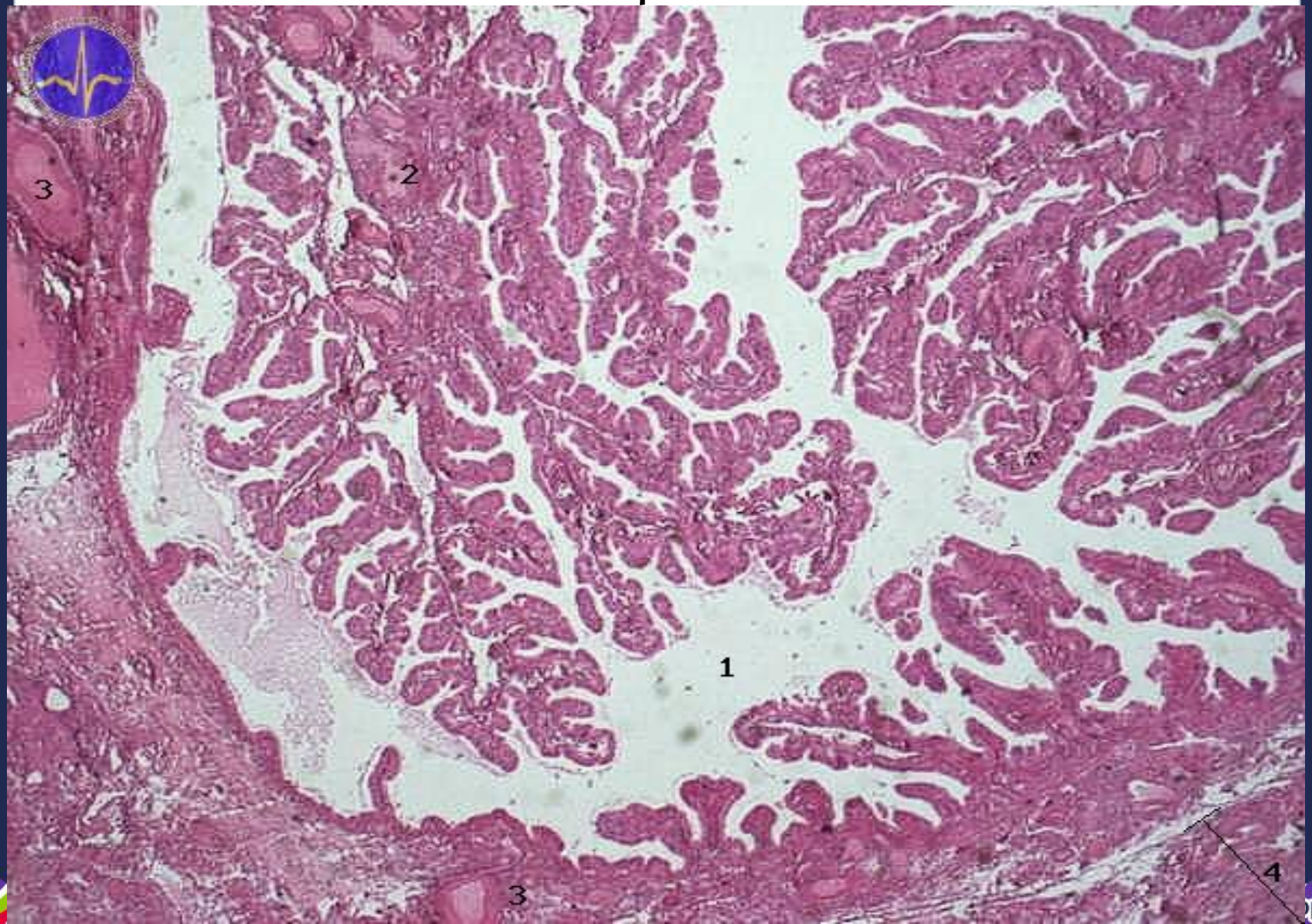
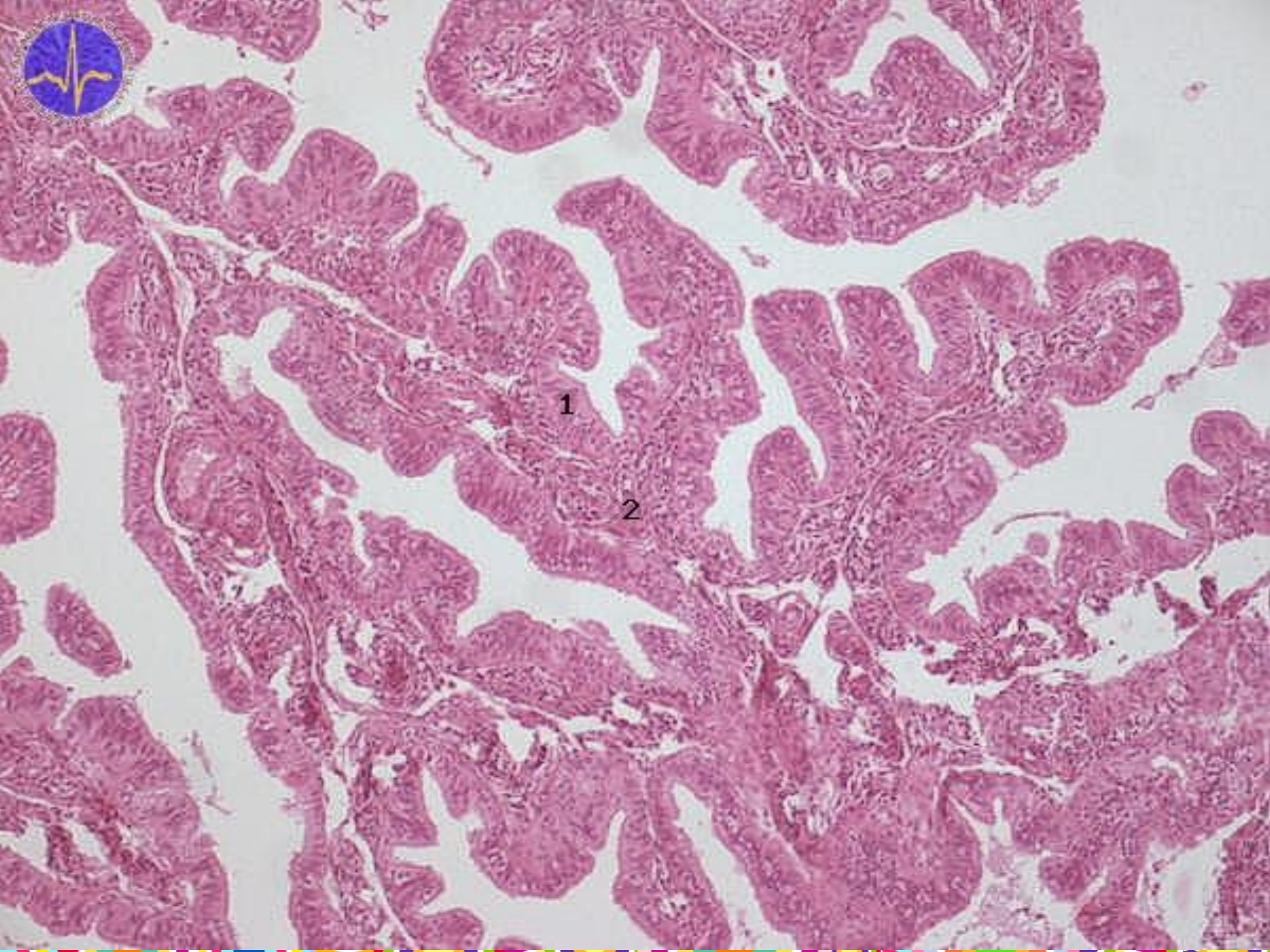
Ampulla




1
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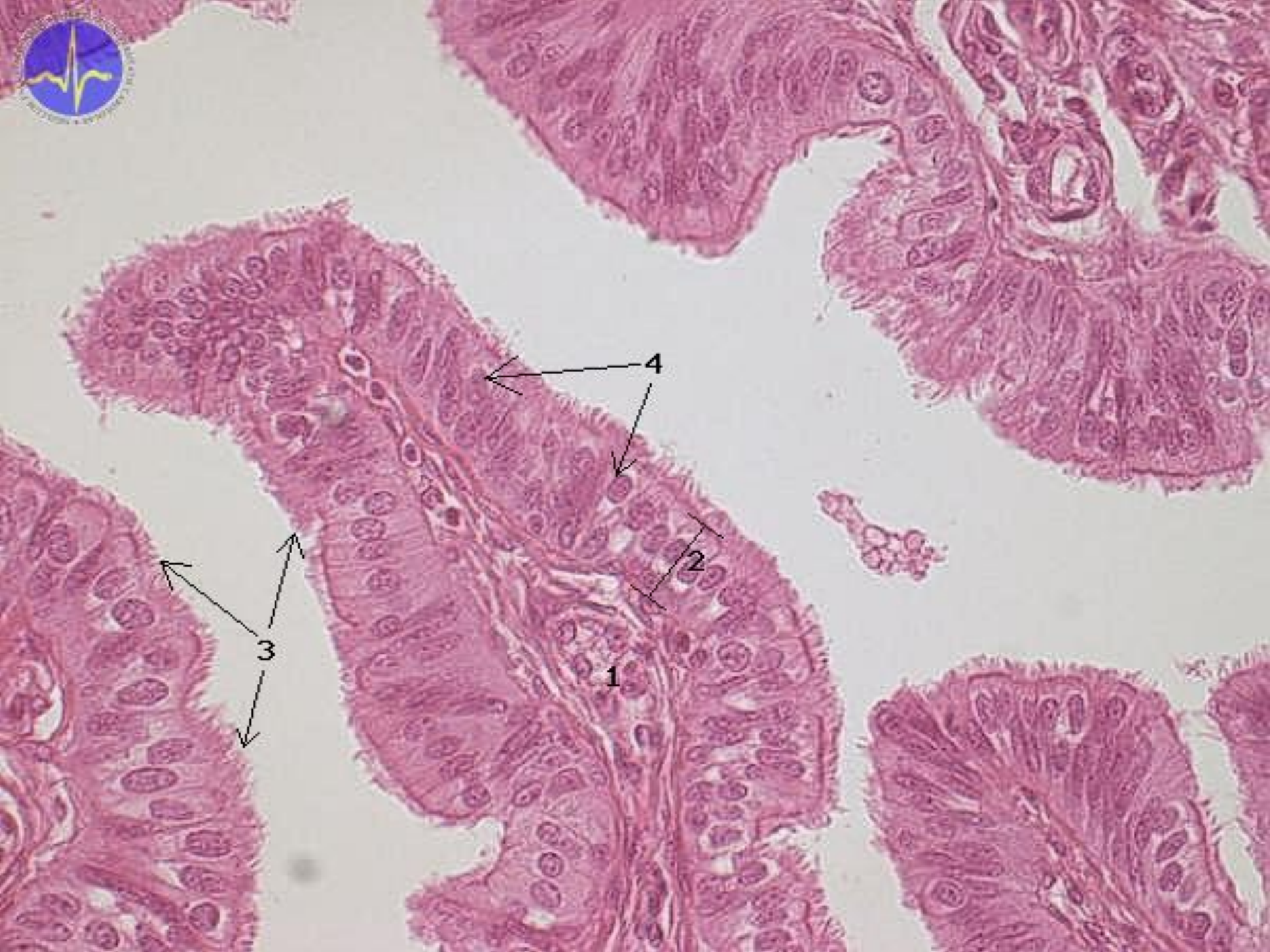
4
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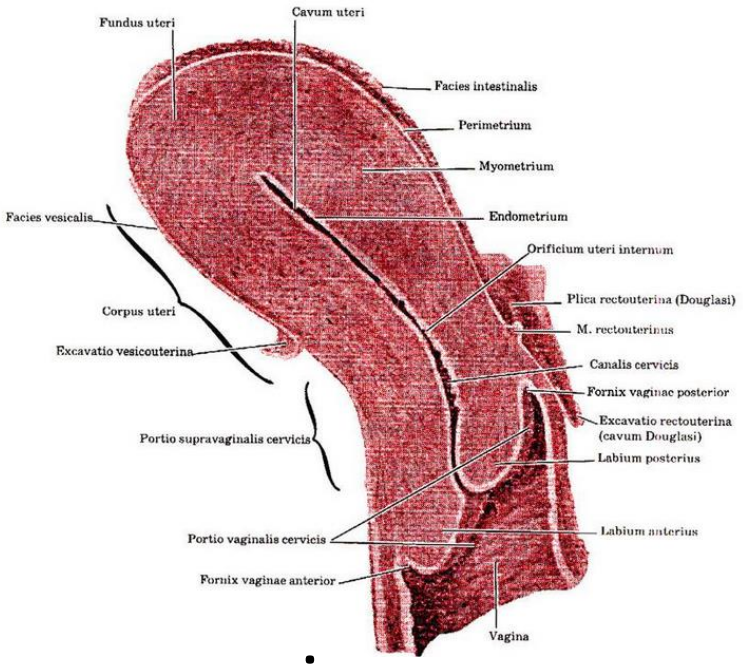
1

Uterus

- Hollow pear-shaped organ
- Thick muscular wall



- Corpus, fundus, isthmus, cervix
- Cavitas uteri, canalis cervicis

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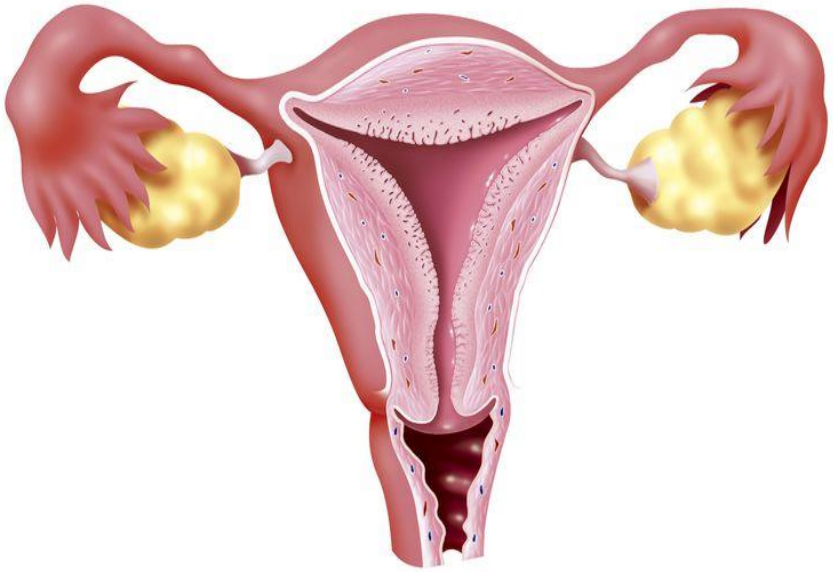
Uterus

- **Endometrium** (tunica mucosa)
- **Myometrium** (tunica muscularis)
- **Perimetrium** (tunica serosa a tela subserosa)
- **Parametrium** (tunica adventitia)



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Endometrium

- **Lamina epithelialis**
  - Simple columnar epithelium
  - Simple tubular uterine glands
- **Lamina propria mucosae**
  - Highly cellular endometrial stroma
- **Stratum functionale**
  - Cyclic changes during the menstrual cycle
- **Stratum basale**
  - Renewal of the cells

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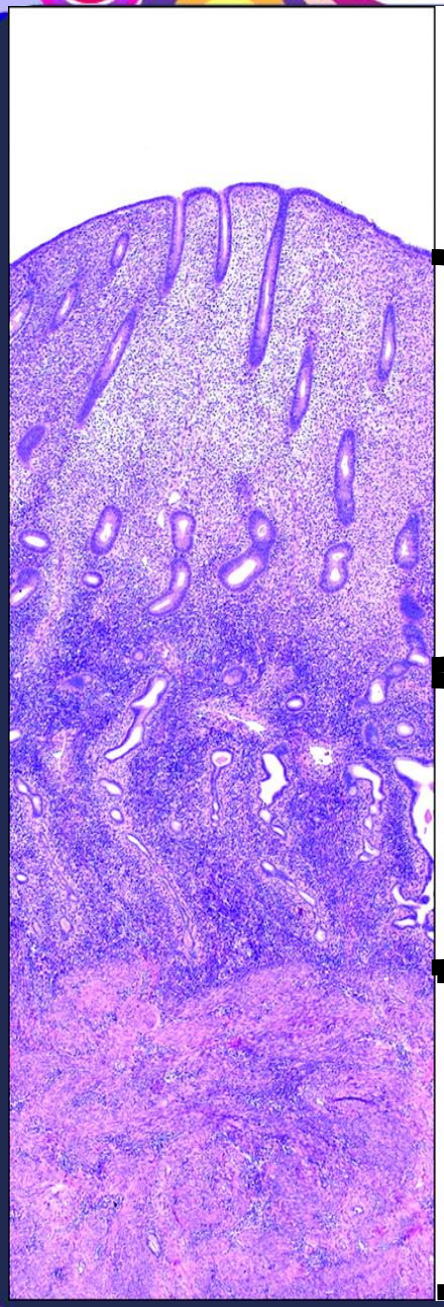
Endometrium



Stratum functionale

Changes during menstruation

Epithelium

Most of the lenght of the glands

Less cellular lamina propria

Stratum basale

Restoration of endometrium after menstruation

Basal ends of uterine glands

Highly cellular lamina propria

Myometrium

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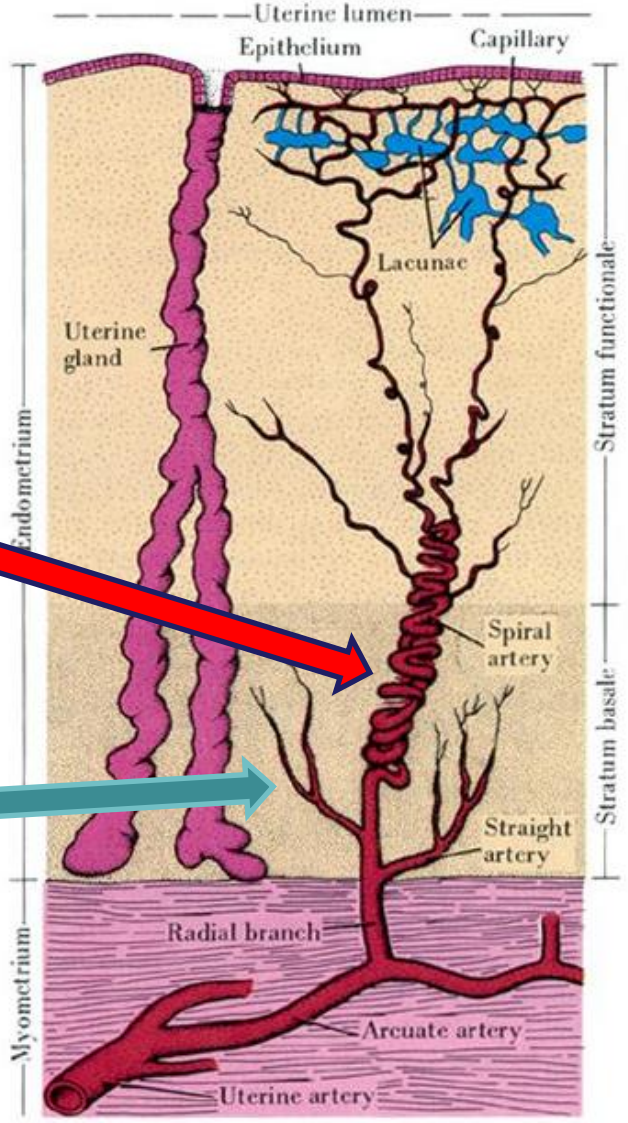
Endometrium
Vascular supply

- **Spiral arteries**
  - Supply functional layer of endometrium
- **Straight arteries**
  - Supply basal layer of endometrium



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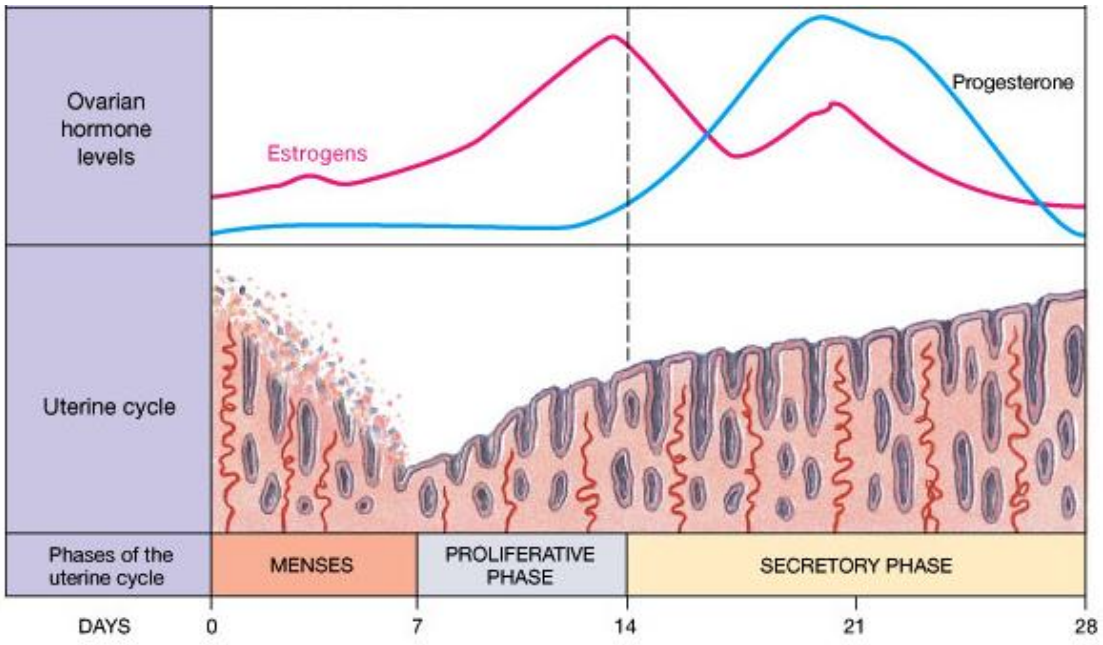
Menstrual cycle

- **Menstrual phase** (1.-4.)
- **Proliferative phase** (5.-14.)
- **Secretory phase** (15.-27.)
- **(Ischemic phase)** (28.)



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Menstrual phase

- Menstrual bleeding
- Result of ischemia of the functional layer of the endometrium
- *Stratum basale* is preserved to restore the endometrium

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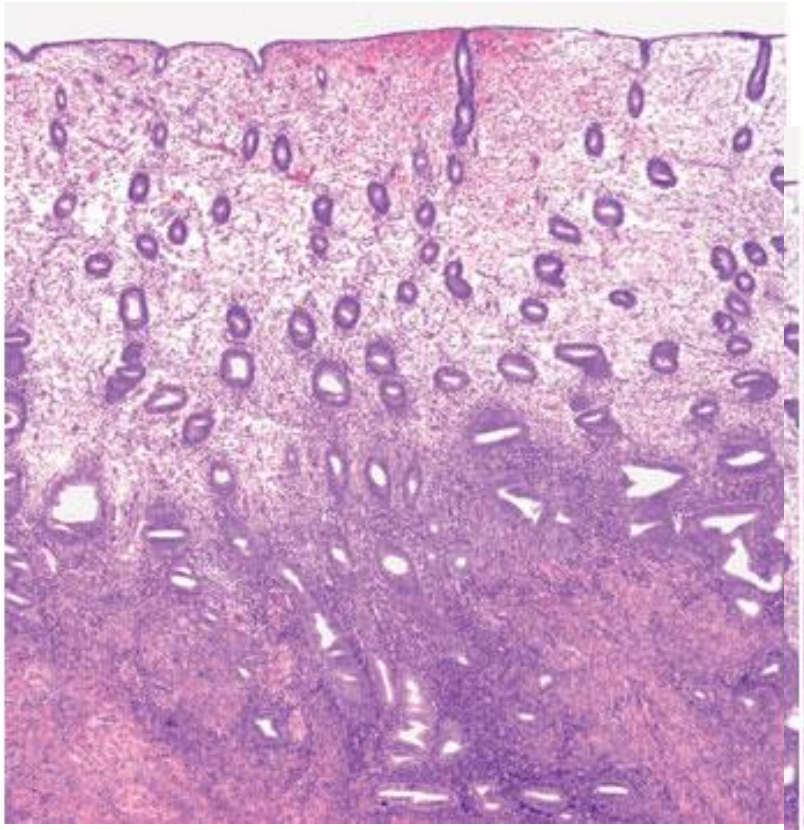
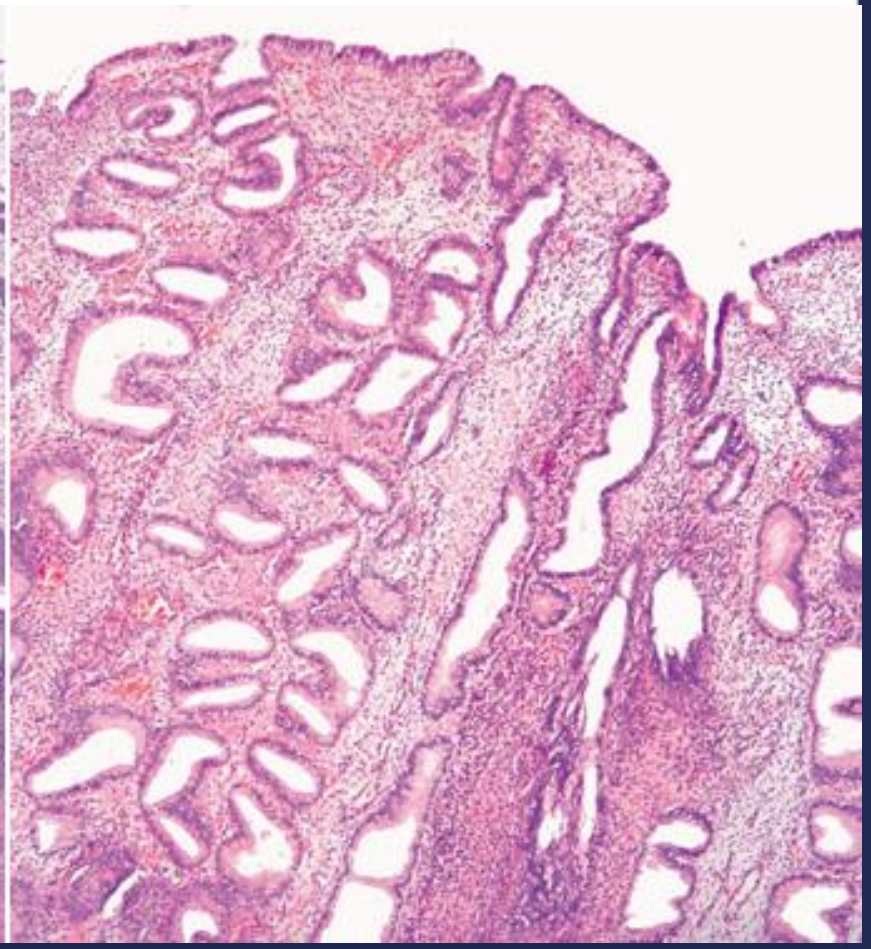
Proliferative phase



The lumen
of gland is empty



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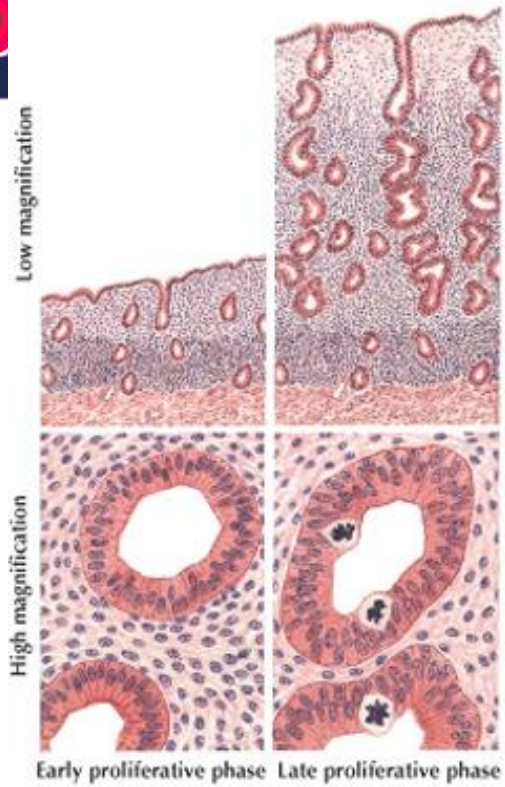
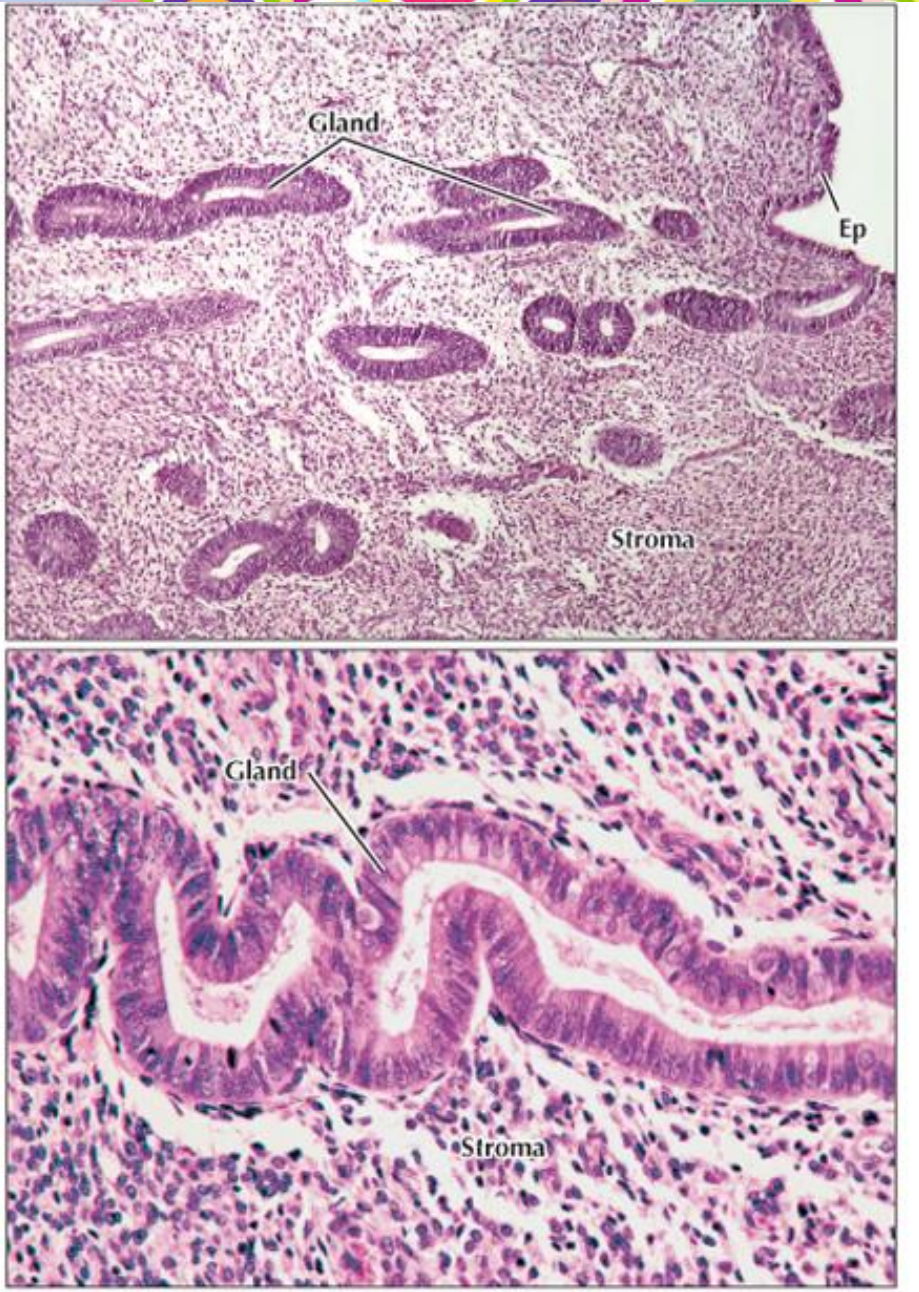


▲ **Schematics of the endometrium during early (left) and late (right) follicular phases of the menstrual cycle.** In the former, the endometrium is relatively thin, and glands are simple and straight. In the late phase, the thicker endometrium shows marked growth in glands and stroma. Uterine glands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



▲ **LMs 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:** 75×; **Below:** 280×. *H&E.*

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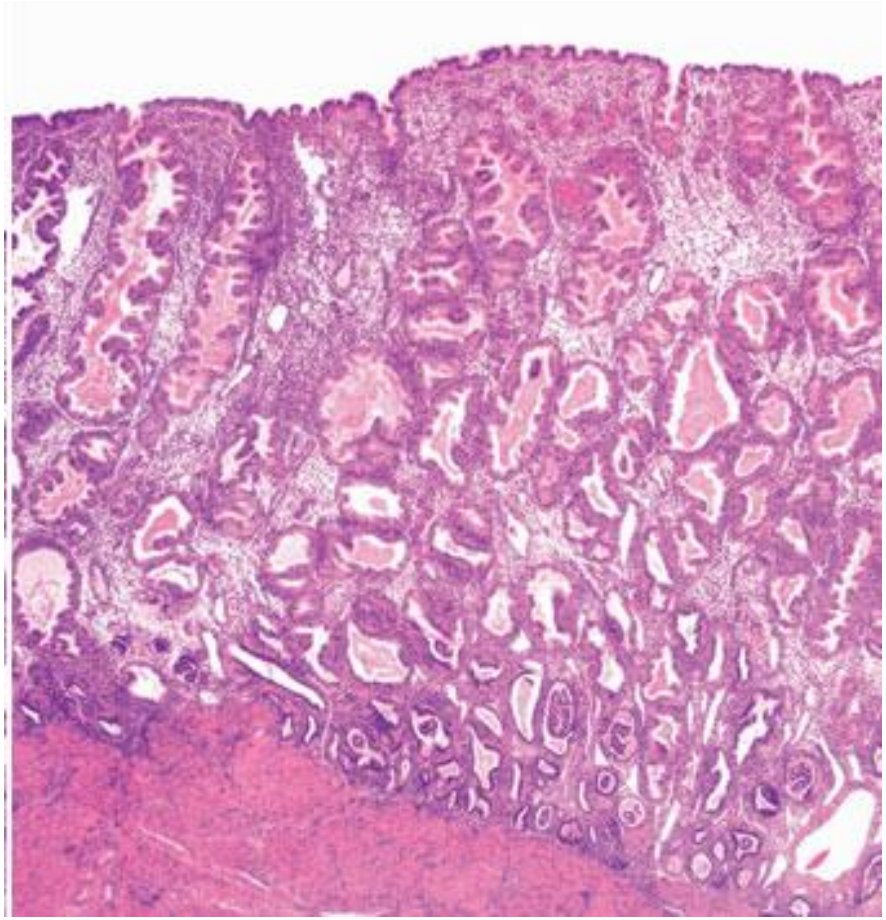
Secretory phase



Glands become coiled

Secretion of glycogen and glycoproteins

Nutrition for the embryo

Progesterone also inhibits contractions of muscles

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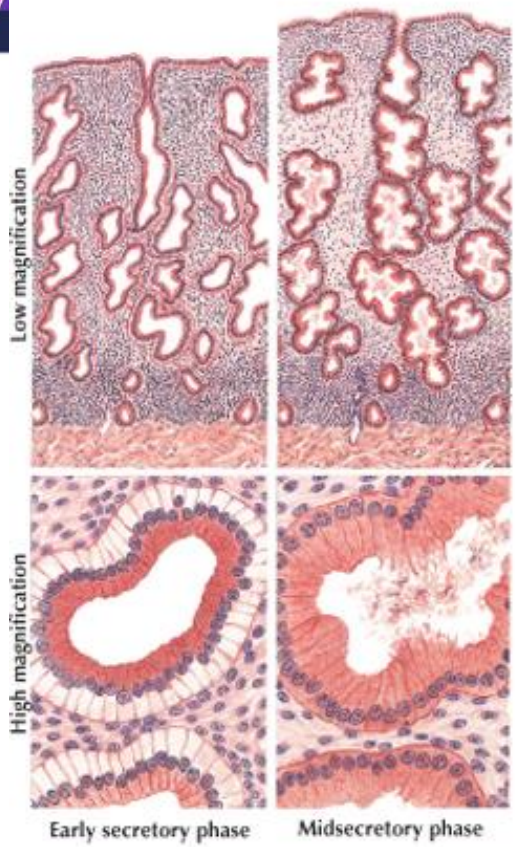
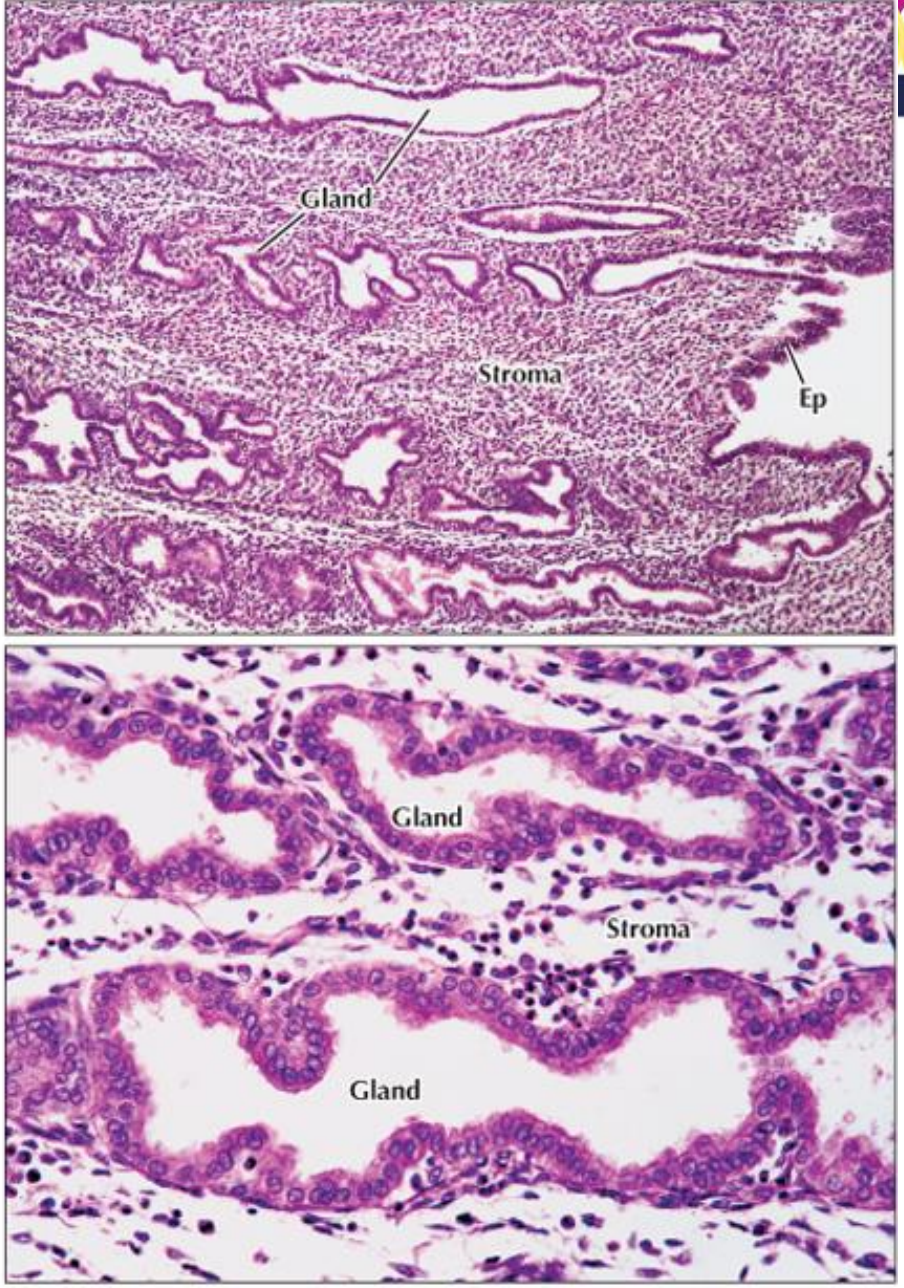


▲ **Schematic of the endometrium during early secretory (left) and midsecretory (right) phases of the menstrual cycle.** In the early phase and under the influence of progesterone, endometrial stroma shows less edema. Epithelial cells of the glands have round nuclei, with pale-staining basal cytoplasm 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.



▲ **LMs of the endometrium during the secretory phase of the cycle at low (Above) and higher (Below) magnification.** Uterine 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.*

23.03.20

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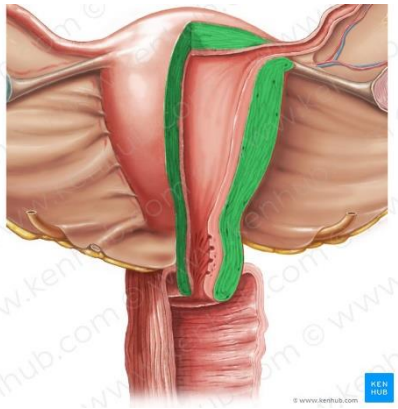
Myometrium

- 4 poorly defined layers of smooth muscle
- Inner layers arranged more spirally
- Outer layer arranged more longitudinaly

- Isthmus – less smooth muscle, more fibrous tissue



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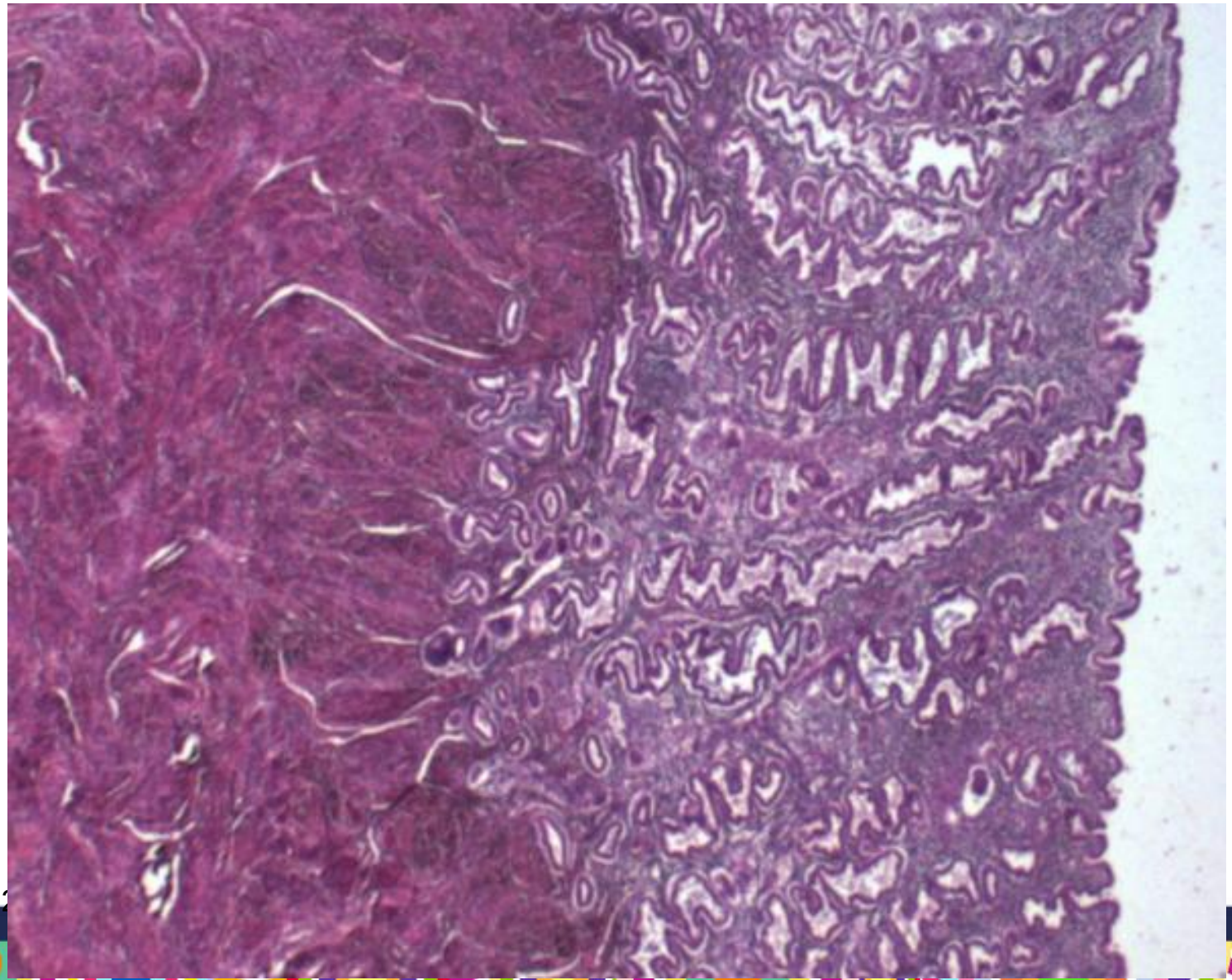
Corpus uteri



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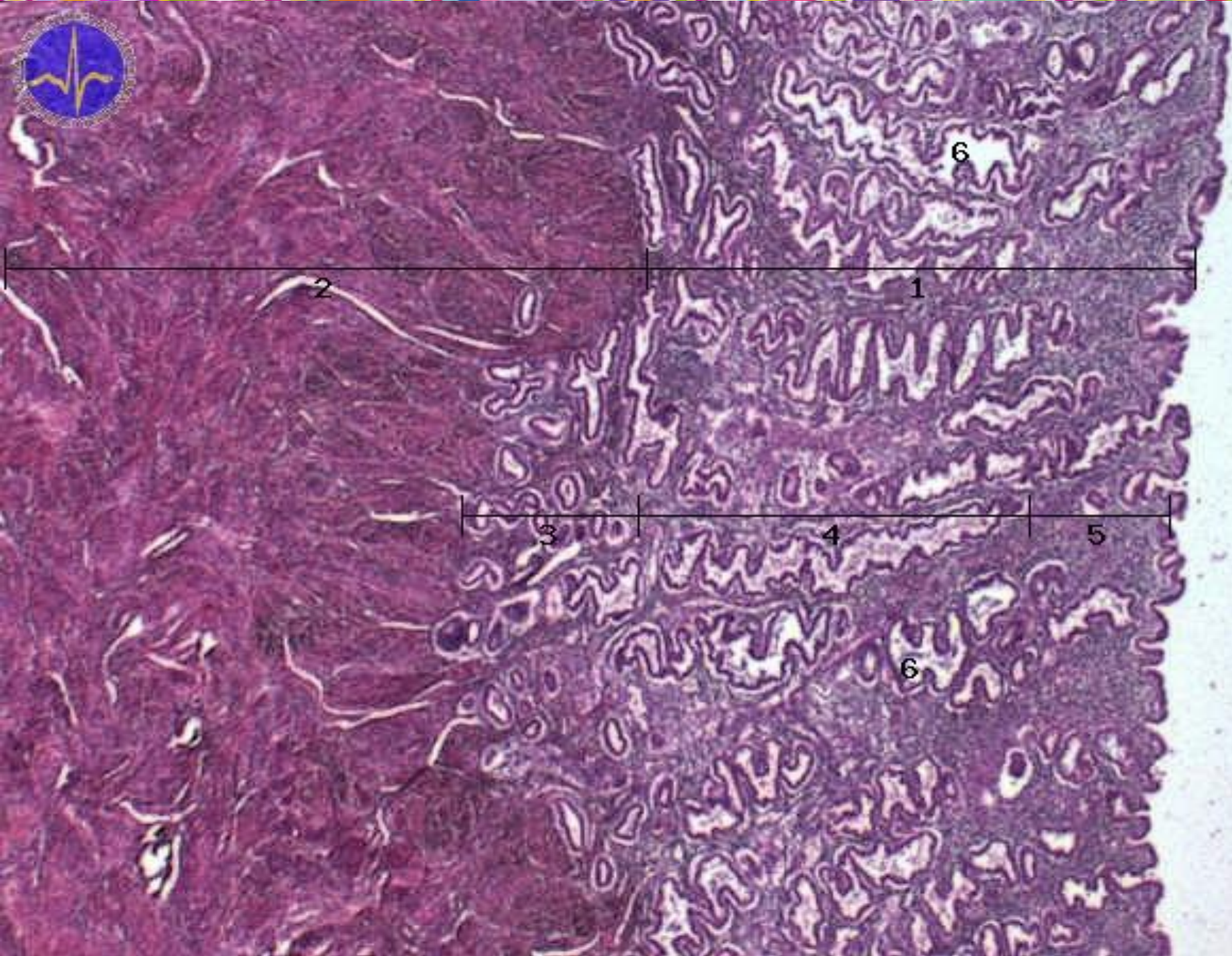
6
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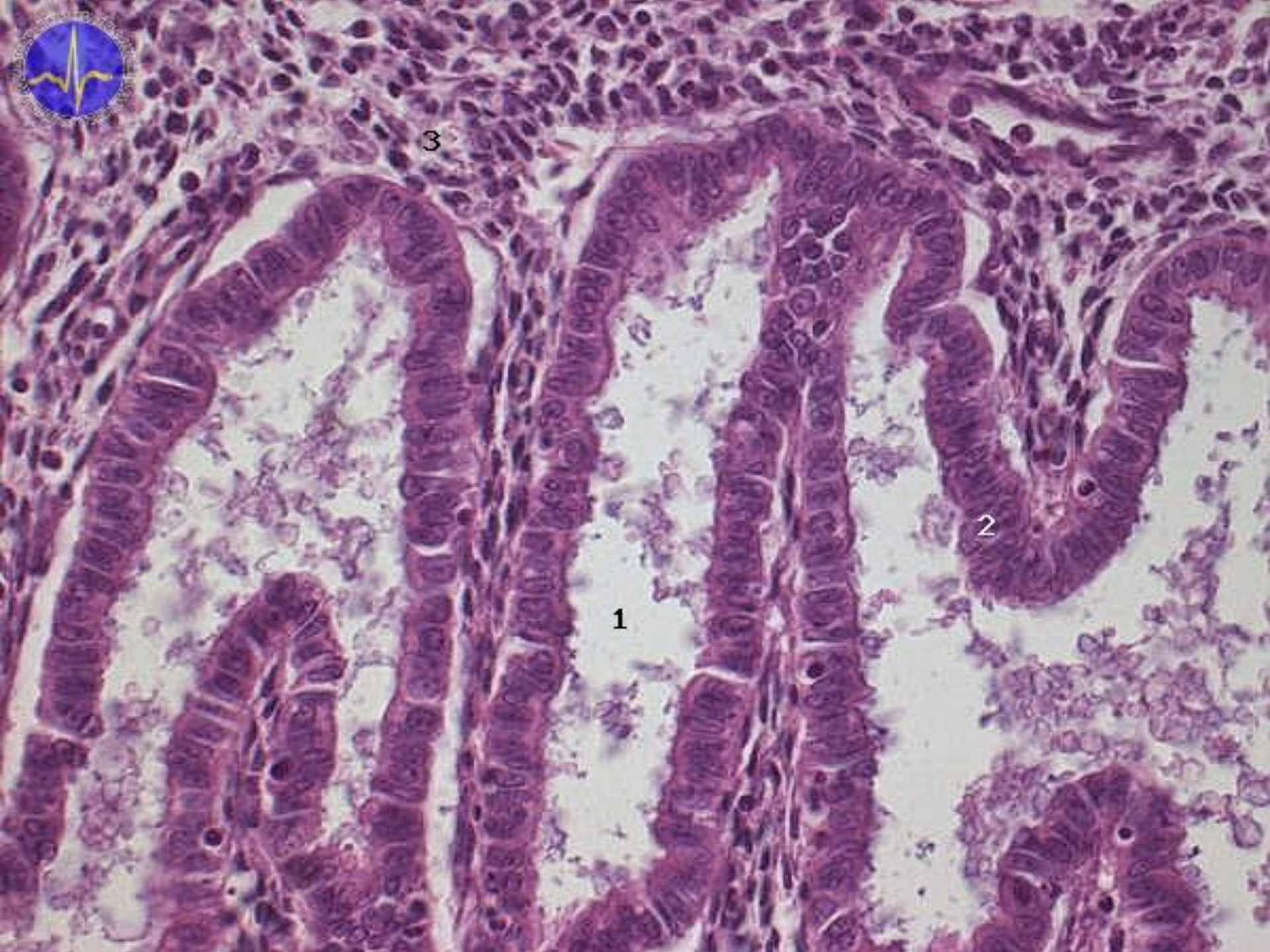
6


3
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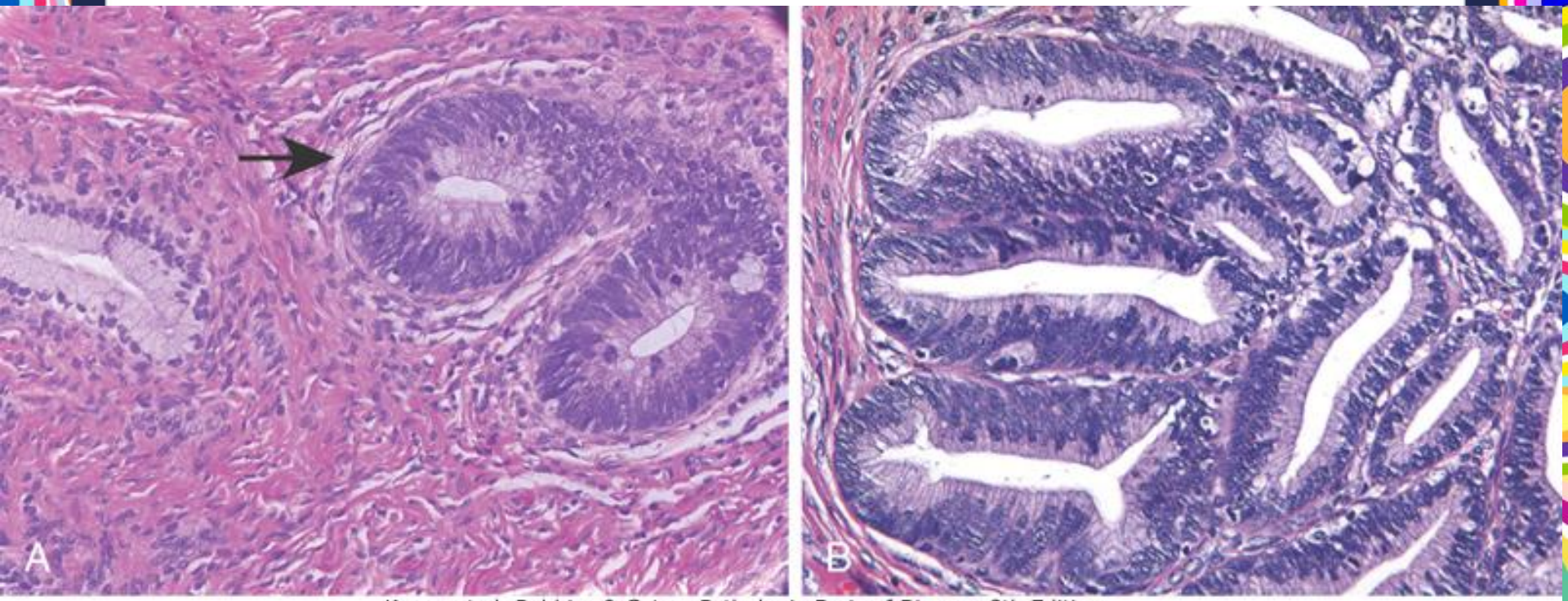
1

Adenoca



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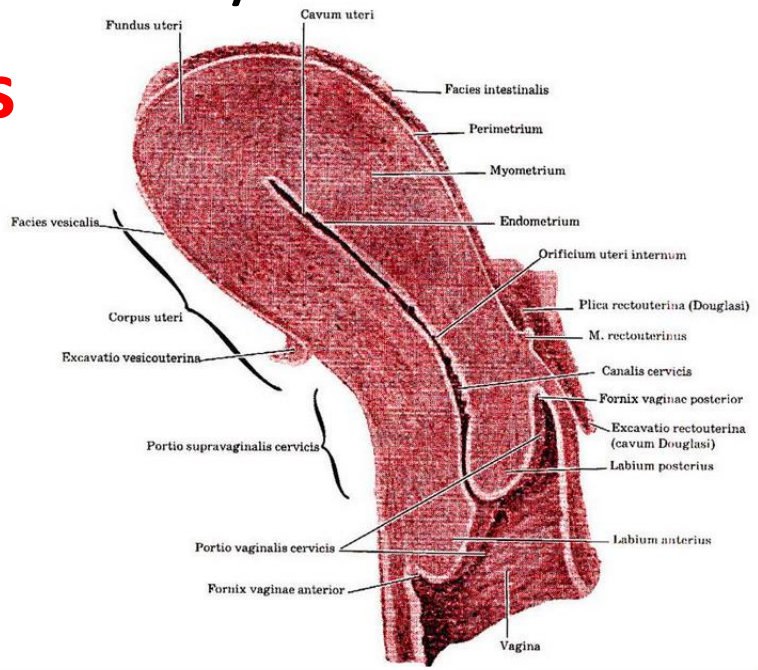
Cervix uteri

= inferior portion of the uterus

- **Portio supravaginalis cervicis** / cervical canal
- **Portio vaginalis cervicis**



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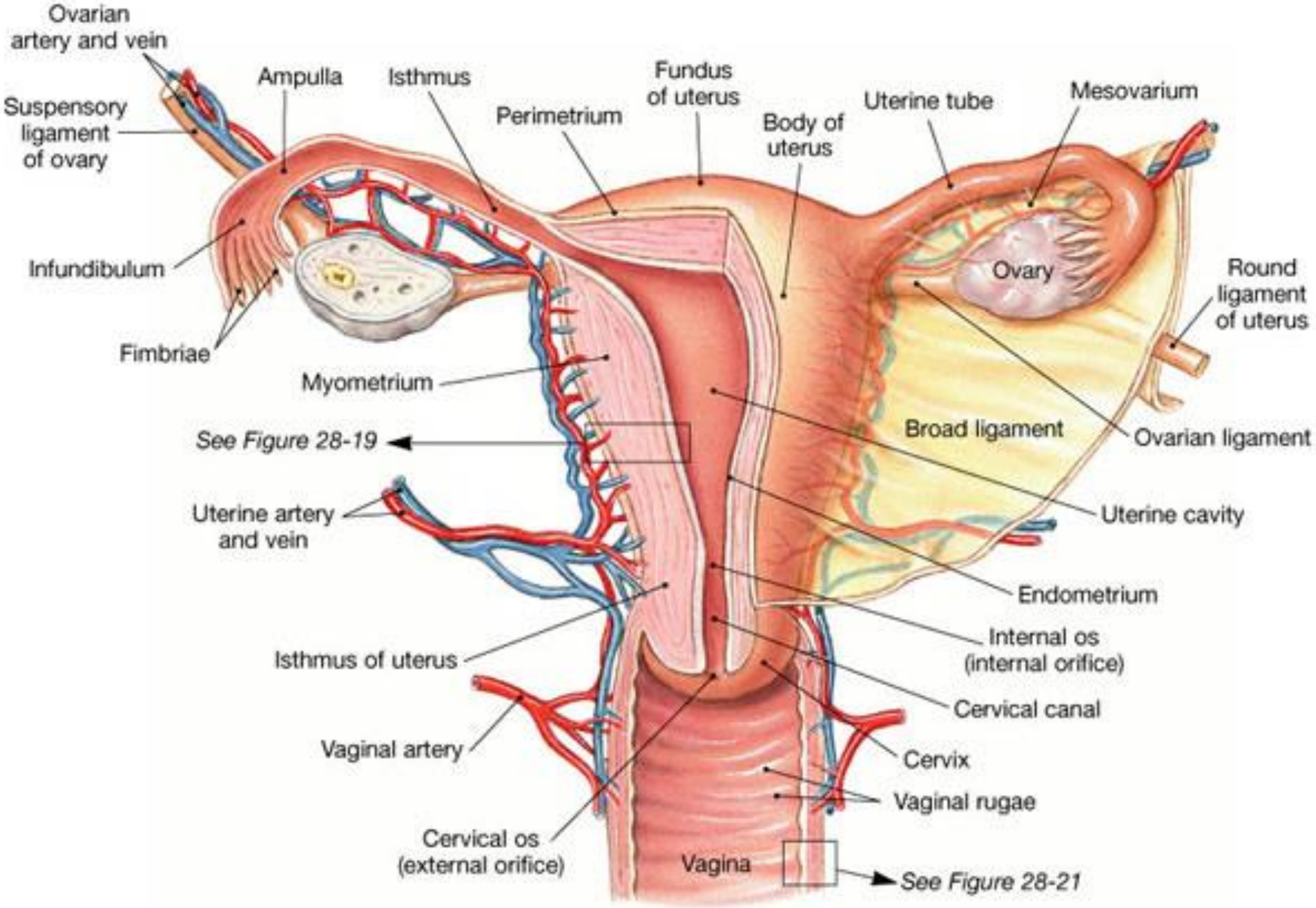

(c) Posterior view

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Portio supravaginalis cervicis

- **Simple columnar epithelium**

- **Glandulae cervicales uteri** (mucous-secreting)
  - Simple tubular glands (crypts)
  - Occluded and dilated = Nabothian cyst

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Portio vaginalis cervicis

- **Nonkeratinized stratified squamous epithelium**
  - Cervicovaginal junction
    - Prepubertal junction inside of cervical canal
    - In fertile age junction is outside the external os (ectropium)
    - **Metaplasia** (= transformation of simple columnar epithelium into normal stratified squamous epithelium) = transformational zone

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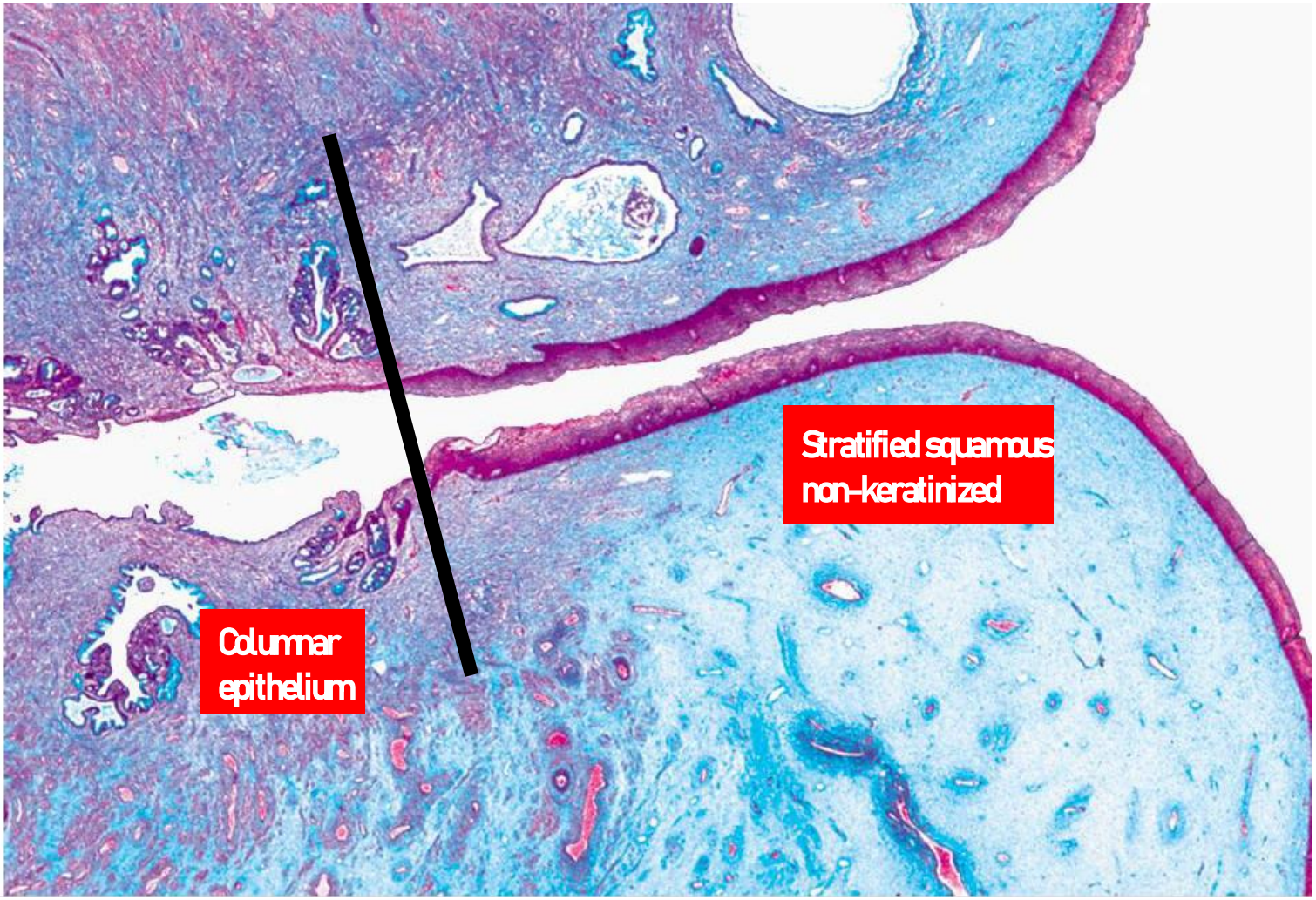
Cervicovaginal junction



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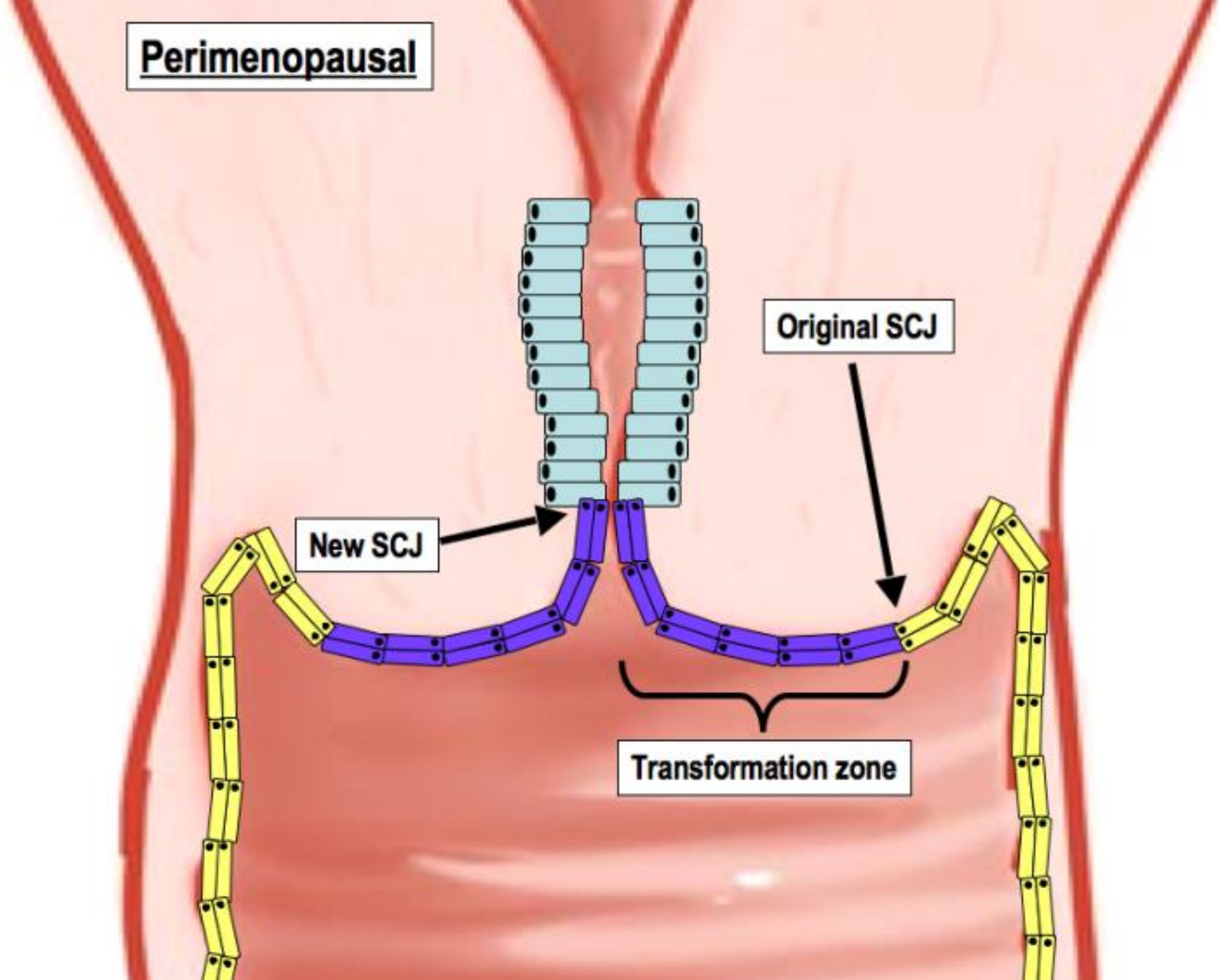
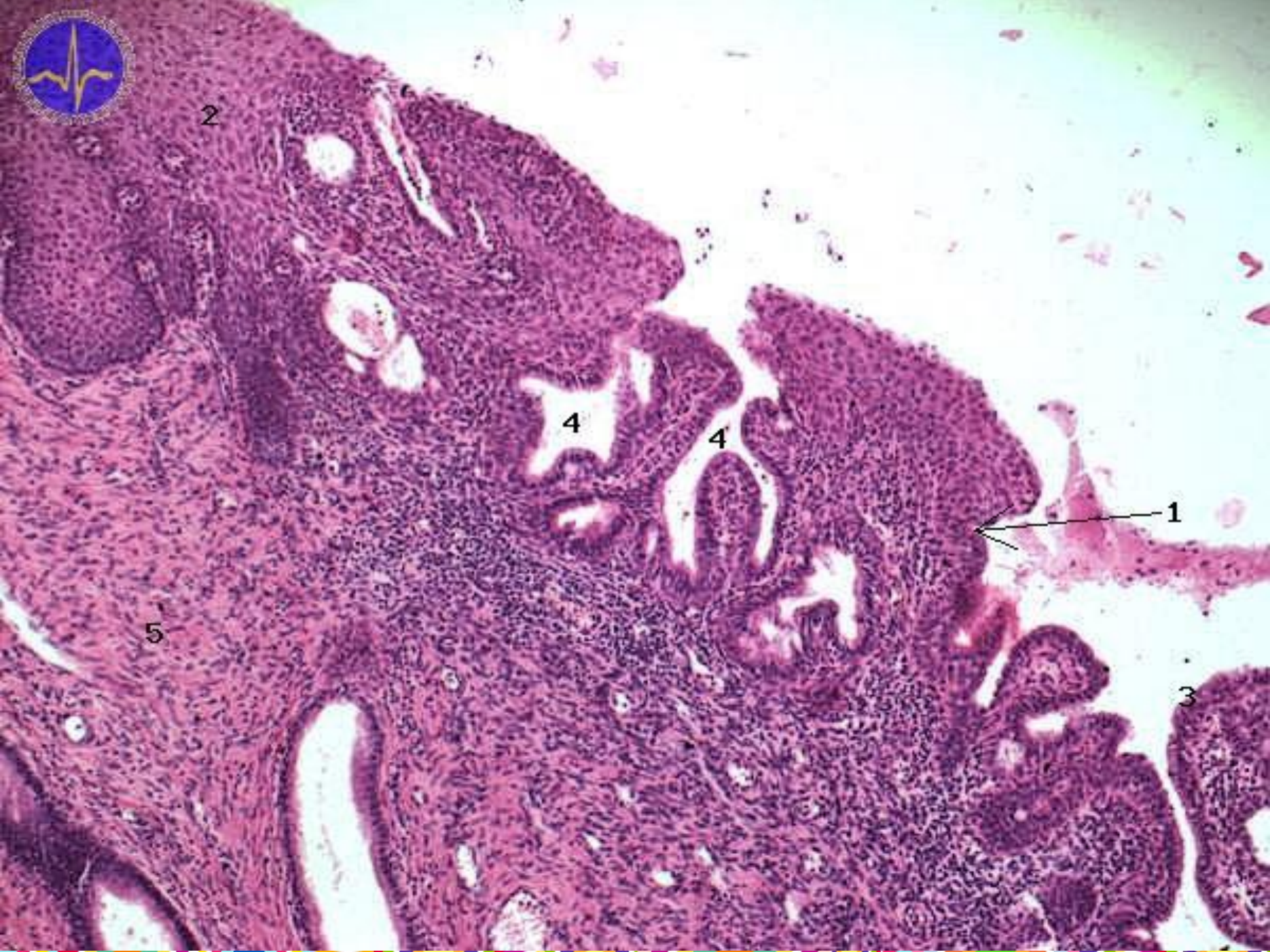
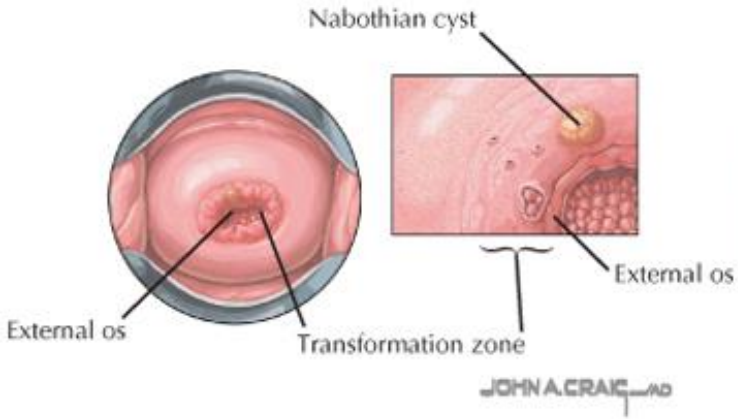
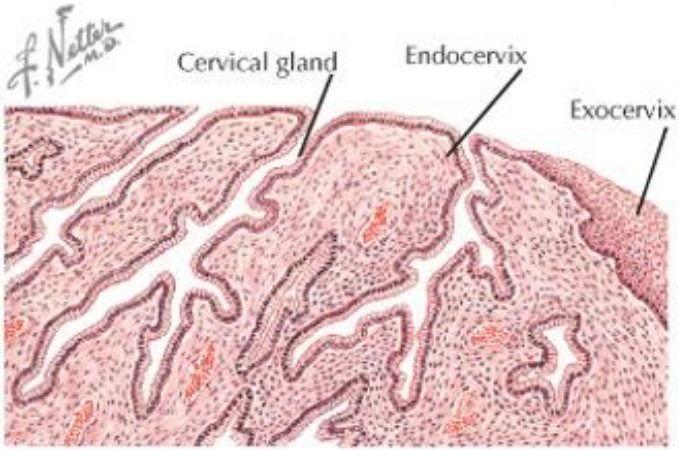

Perimenopausal
Original SCJ
New SCJ
Transformation zone


2
4
4
1
5
3

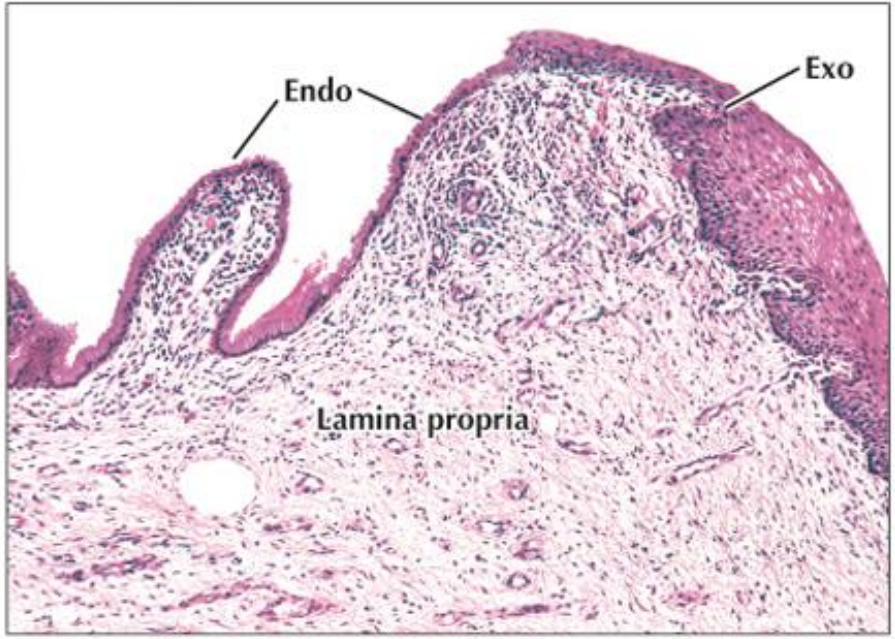
▼ **Low- and high-power colposcopic views of the normal transformation zone.**



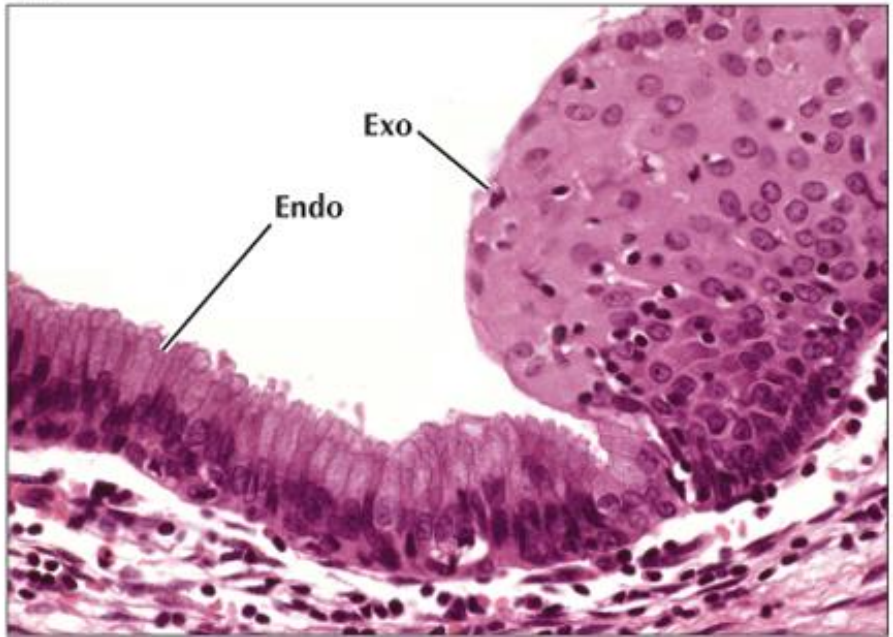


▲ **Schematic of the cervical squamocolumnar junction.**

► **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.*



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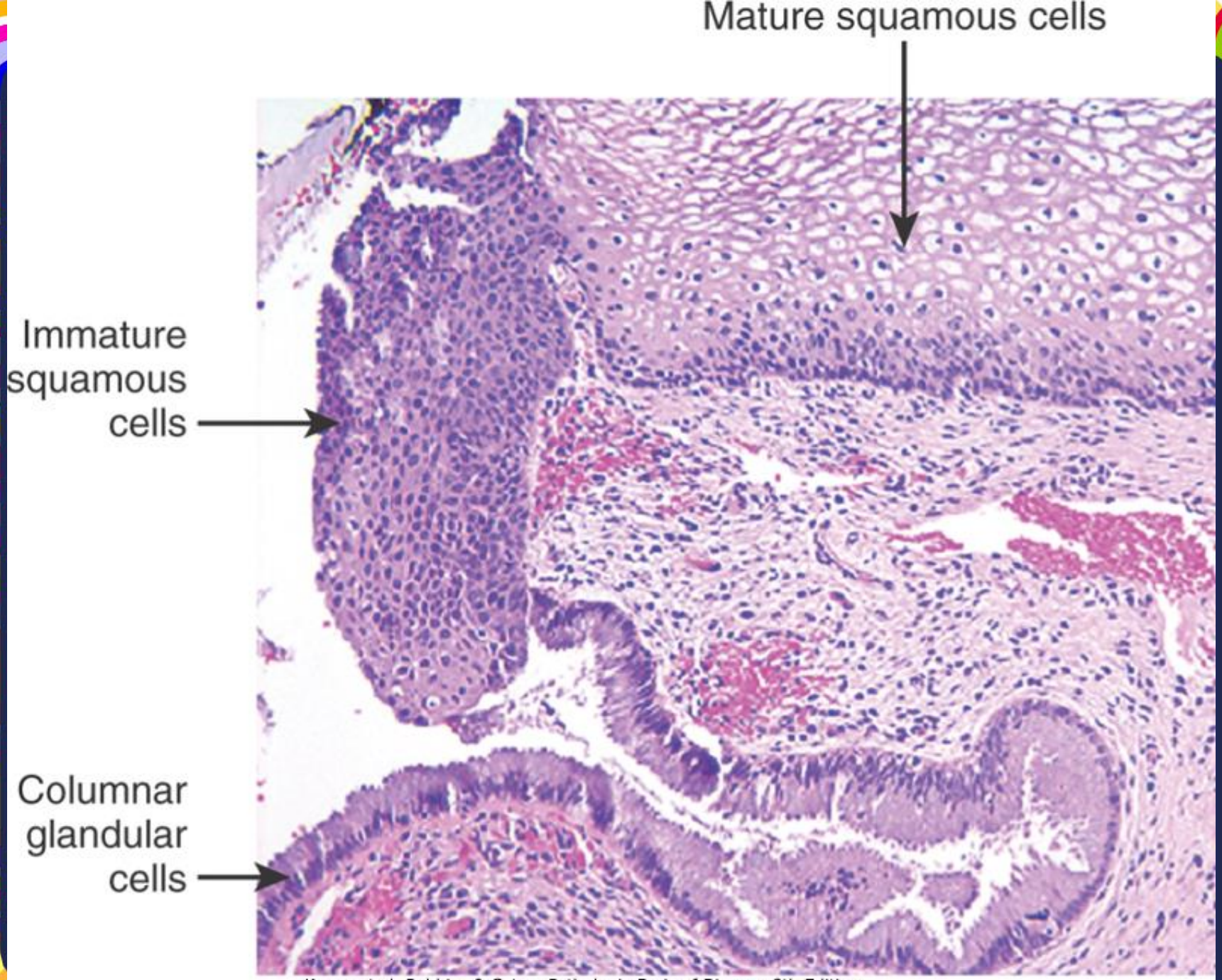

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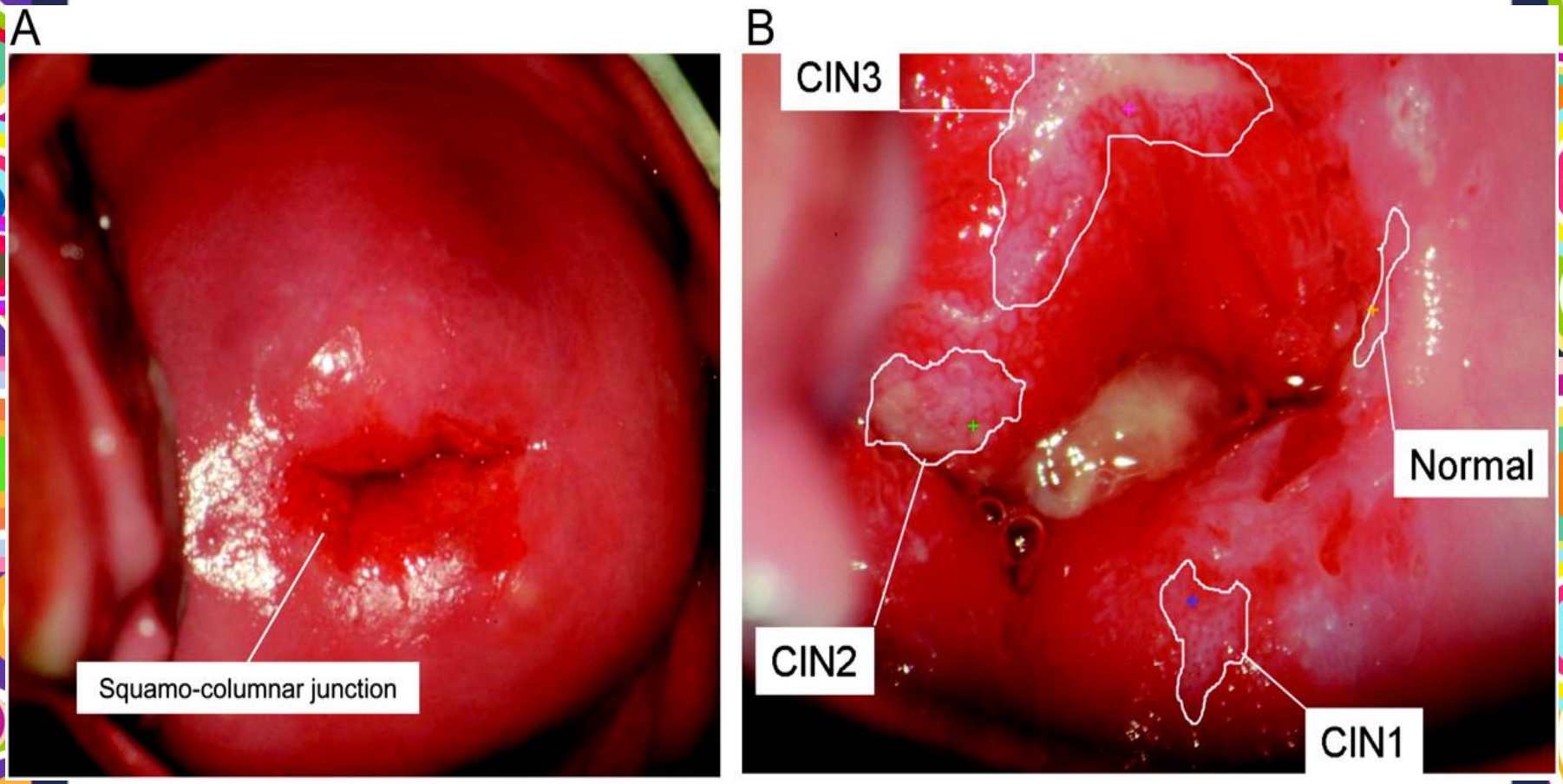
Cervical metaplasia



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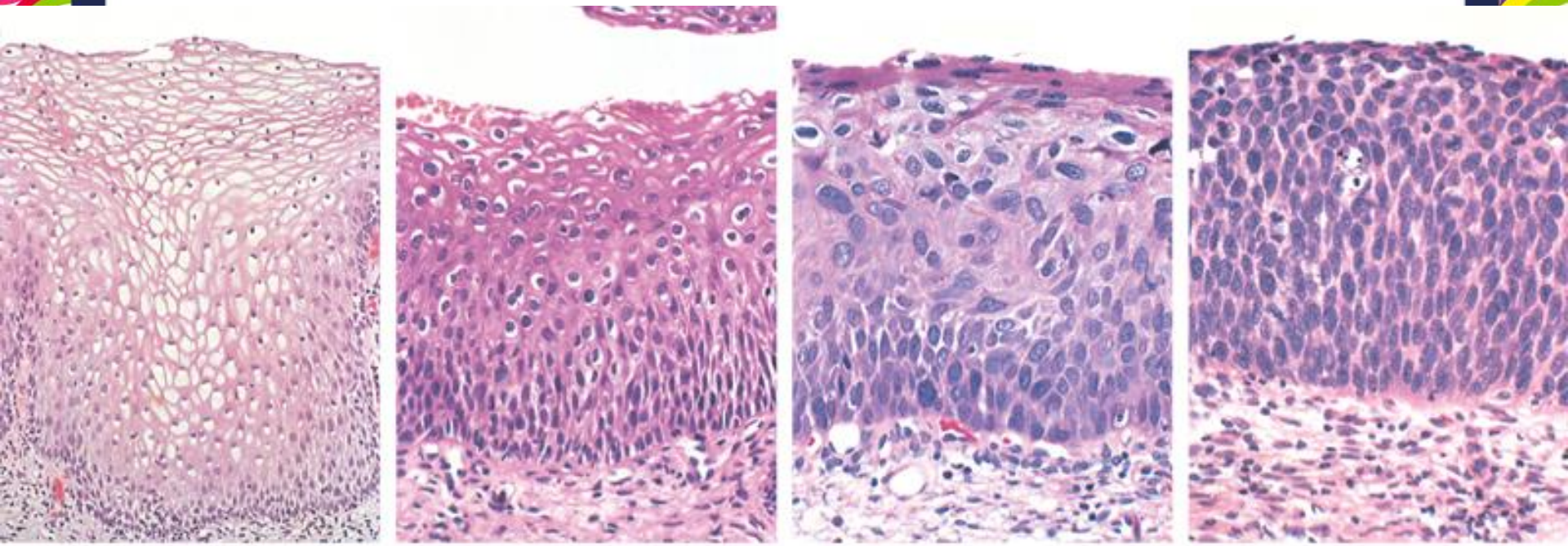

Normal CIN I CIN II CIN III

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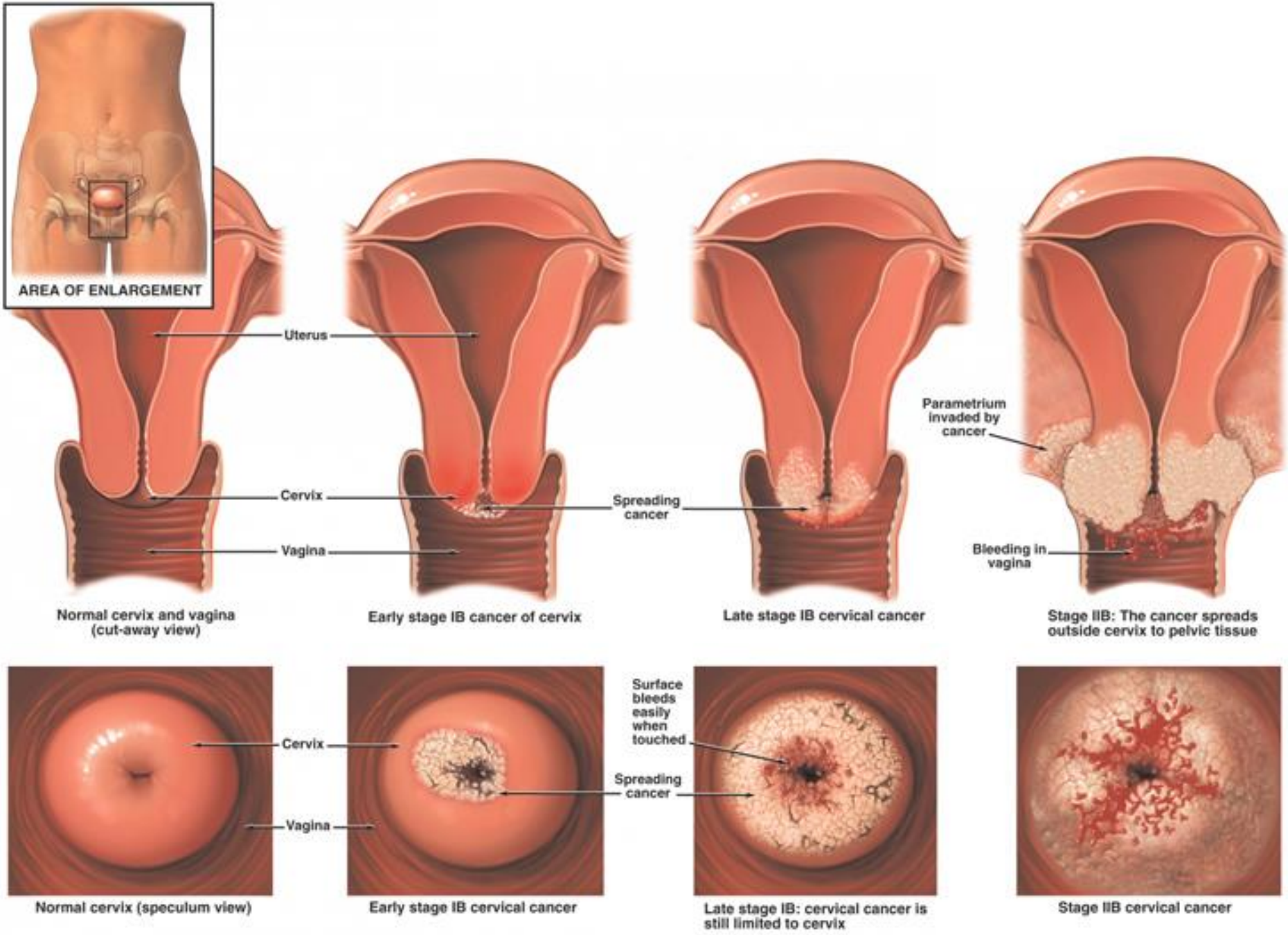
AREA OF ENLARGEMENT
Uterus
Cervix
Vagina
Spreading cancer
Parametrium invaded by cancer
Bleeding in vagina
Normal cervix and vagina (cut-away view)
Early stage IB cancer of cervix
Late stage IB cervical cancer
Stage IIB: The cancer spreads outside cervix to pelvic tissue
Cervix
Vagina
Spreading cancer
Surface bleeds easily when touched
Normal cervix (speculum view)
Early stage IB cervical cancer
Late stage IB: cervical cancer is still limited to cervix
Stage IIB cervical cancer

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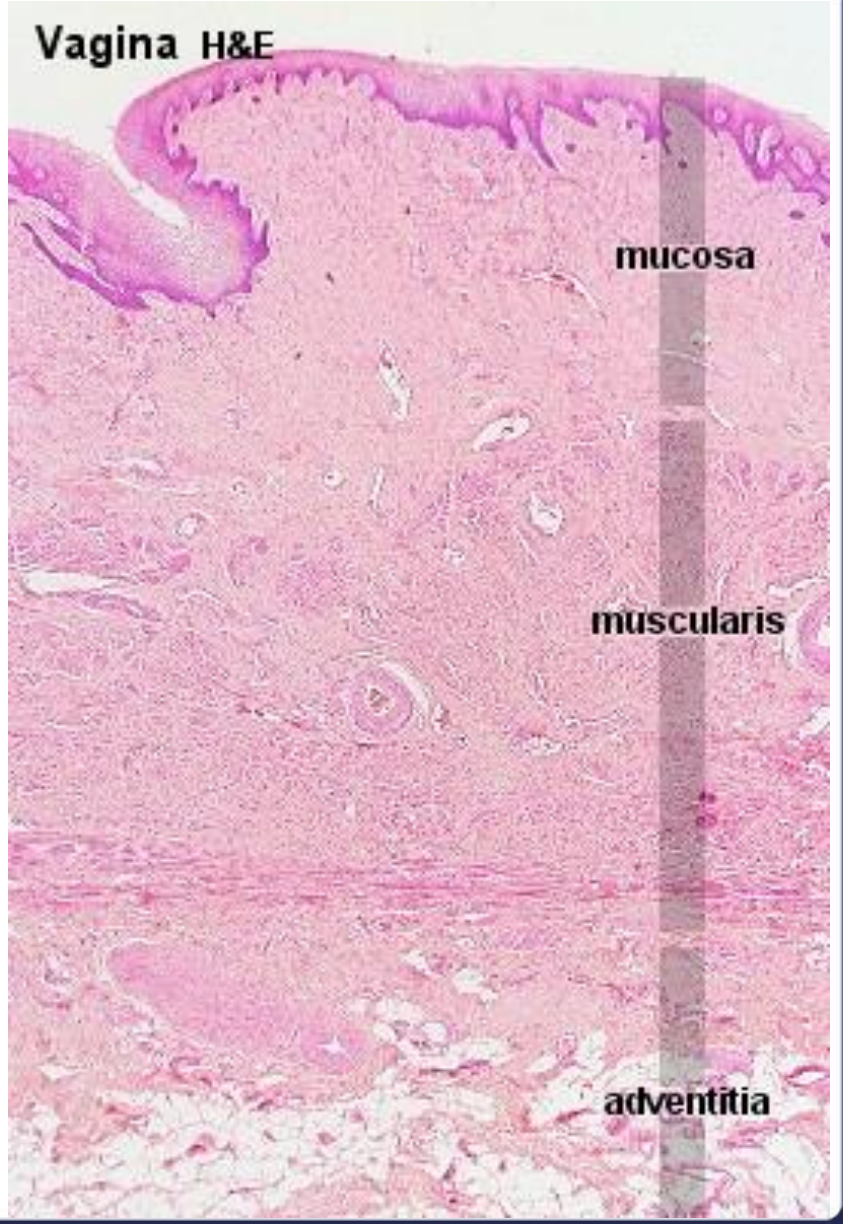
Vagina

- **Tunica mucosa**
- **Tunica spongiosa**
- **Tunica muscularis**
  - Smooth muscle
    - inner(circular)
    - outer (longitudinal)
- **Tunica adventitia**



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Mucosa

- Nonkeratinized stratified squamous epithelium
- Lamina propria mucosae

- **NO GLANDS!!!**

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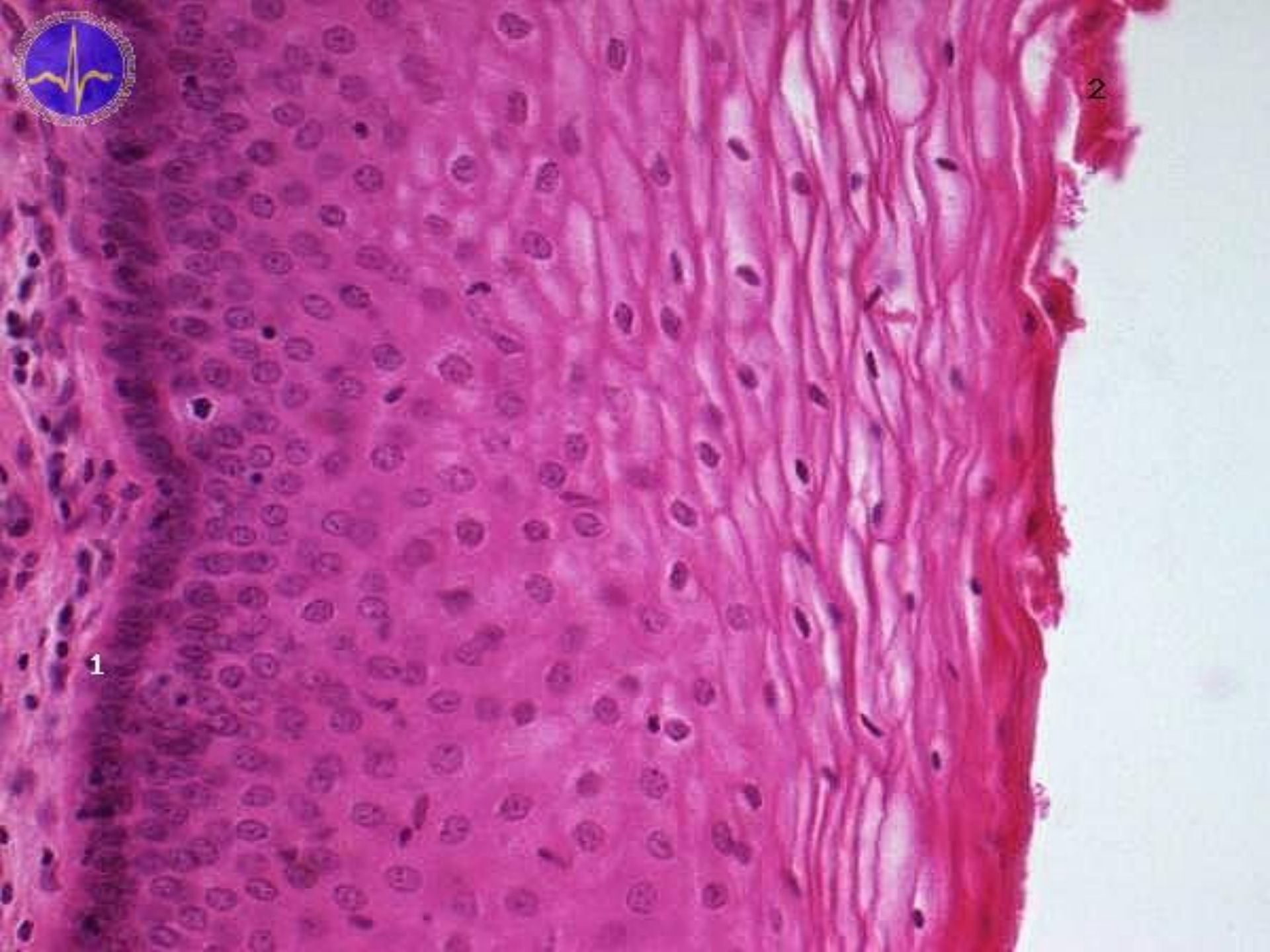
2
1

2
1

Mucosa

- Transverse folds = rugae

- Epithelial cells
  - Cytoplasmatic storage of glycogen
  - Glycogen = nutrition for microbial flora (Döderlein‘s bacillus)
  - Causes the acidofied enviroment (pH 4-5)

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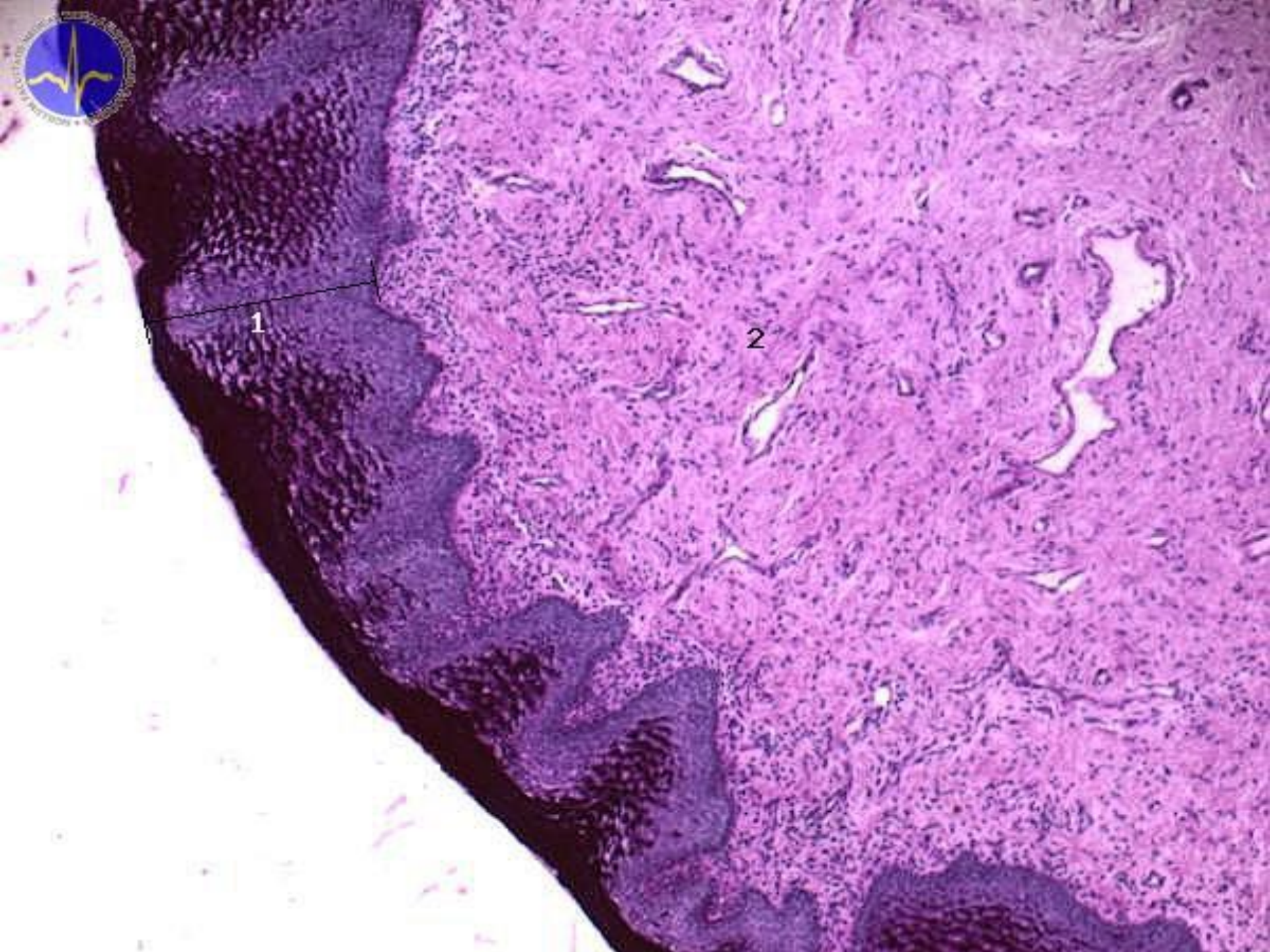
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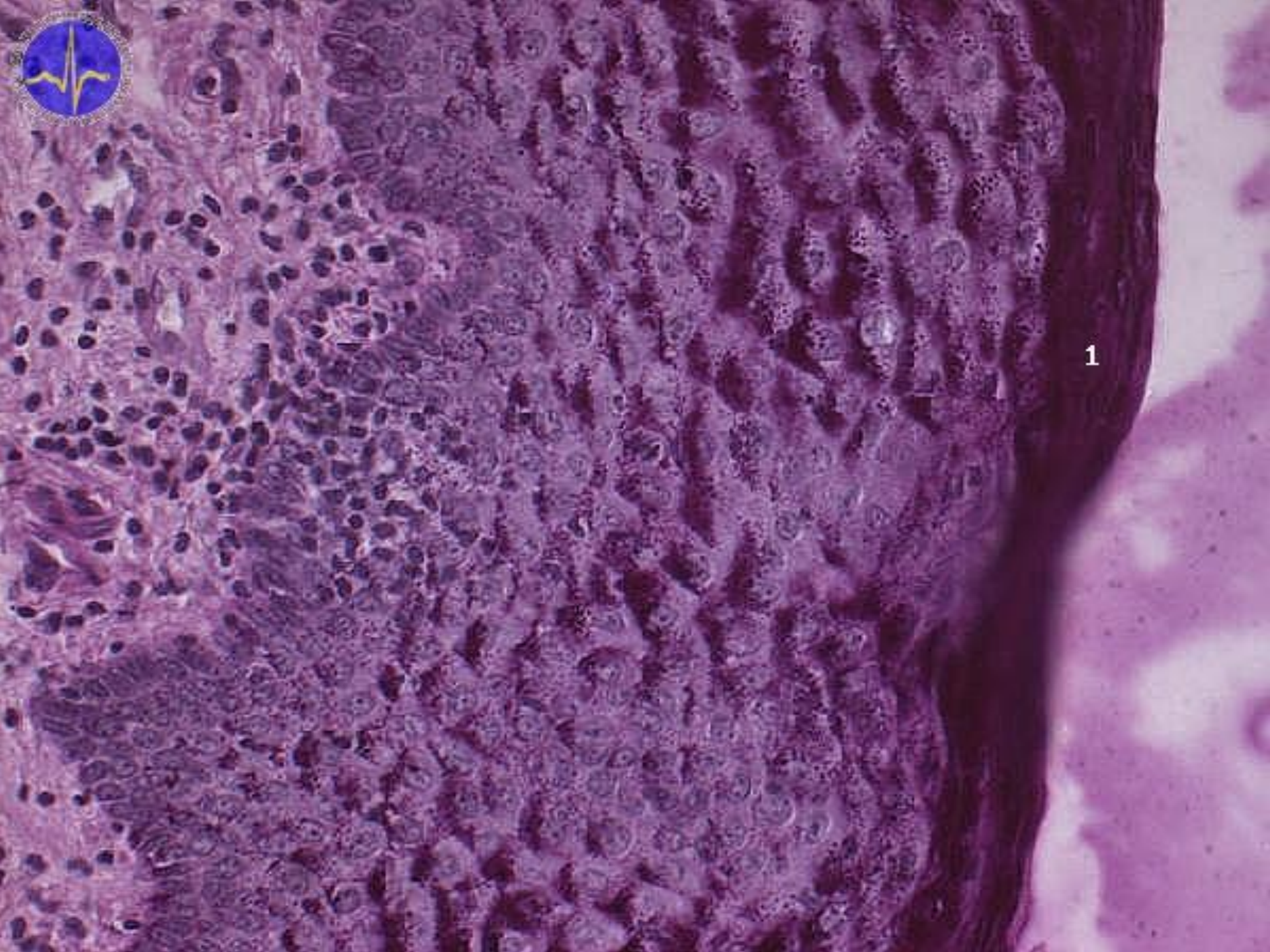
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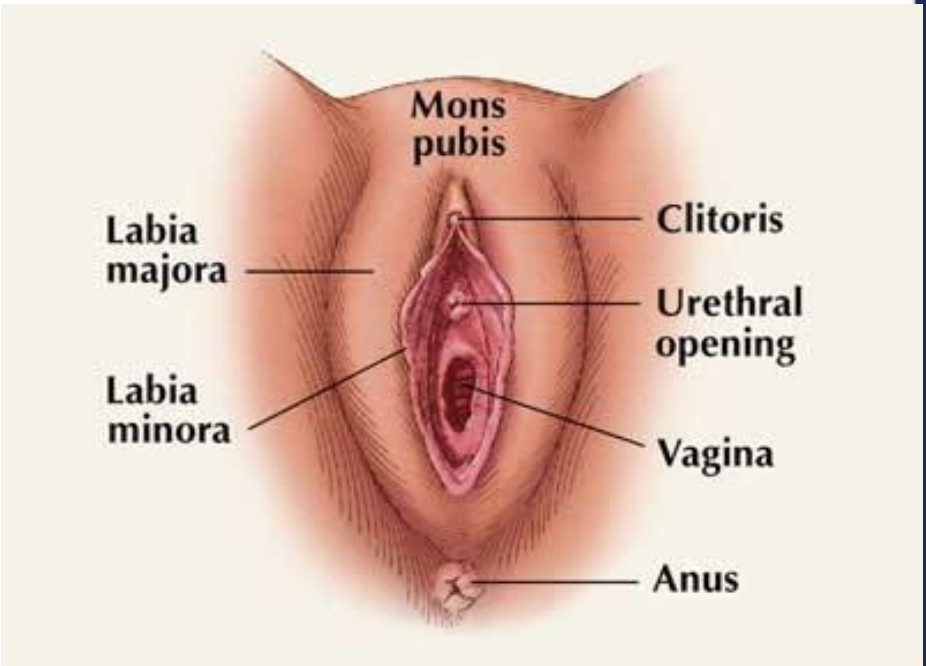
Vulva

- Clitoris
- Labia minora
- Labia majora
- Vestibulum vaginae



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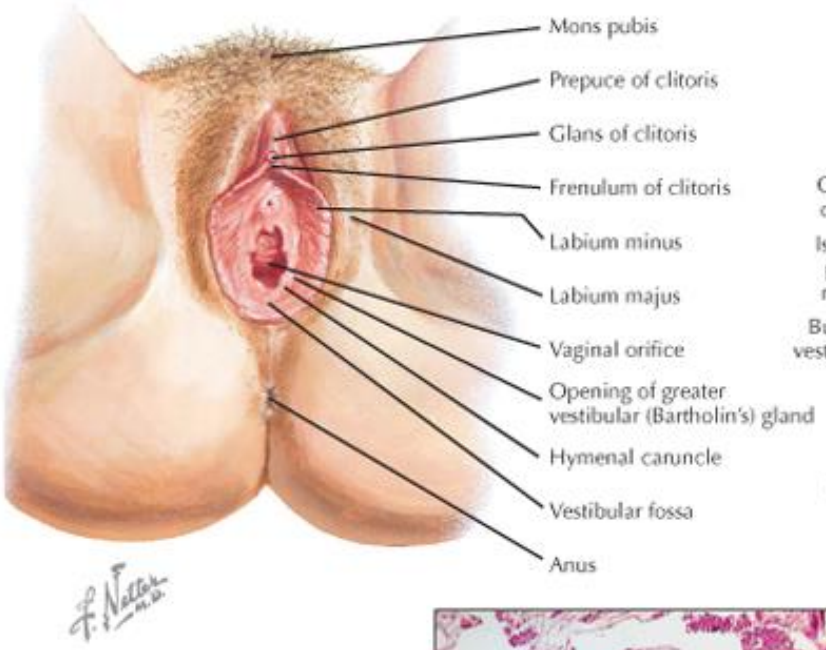
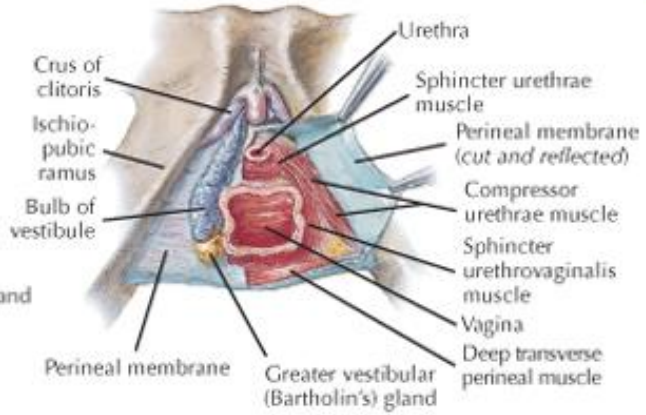
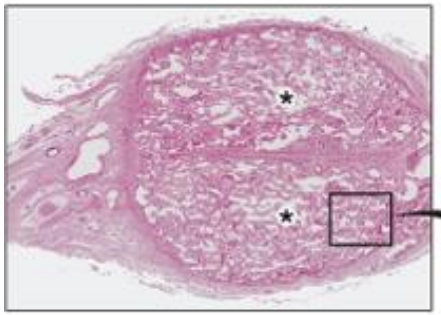
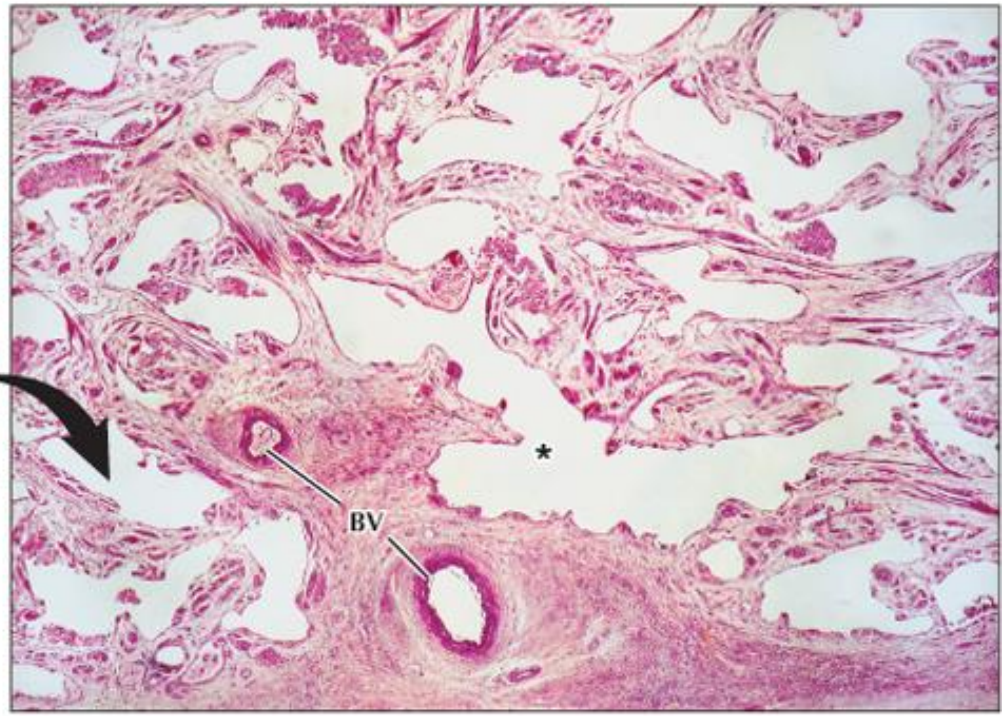






▲ **Low-magnification LM of the clitoris in transverse section.** The organ comprises two corpora cavernosa (*). They contain erectile tissue, which accounts for the spongy appearance. 3×. *H&E.*



▲ **Higher magnification LM of erectile tissue of the clitoris.** An anastomotic network of many thin-walled vascular channels (*) makes up the erectile tissue. Surrounding connective tissue contains blood vessels (**BV**) with thicker walls. 30×. *H&E.*

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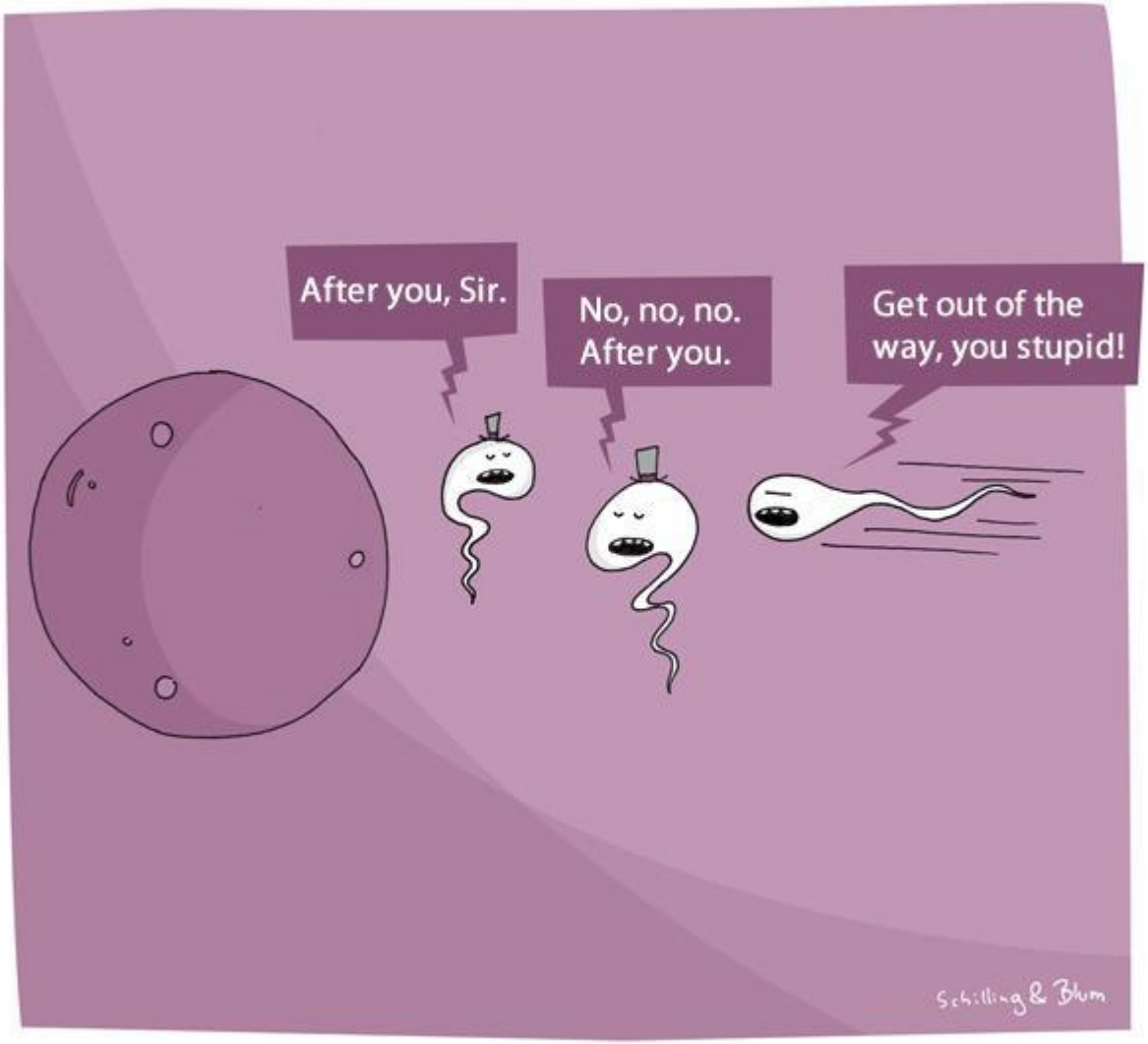

How the gentlemen died out

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