17-00 Female Reproductive System

17-00 Female Reproductive System



17 Female Reproductive System Menu 1/2

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- <u>17-01</u>. Scheme showing the female reproductive System.
- <u>17-001</u>. Ovary
- 17-02. Ovary and oviduct. General view. Monkey, H-E stain, x 1.2.
- <u>17-03</u>. Overy Sagitall section, general view. Monkey, H-E stain, x 2.0.
- <u>17-04</u>. Ovary containing a large corpus luteum. Human, H-E stain, x 1.15.
- <u>17-05</u>. Cortex of ovary. Human, H-E attain, x 25.
- <u>17-06</u>. Primordial egg follicles 1. Monkey, H-E stain, x 160.
- <u>17-07</u>. Scheme showing the development of egg follicles and corpus luteum.
- <u>17-08</u>. Primordial egg follicle 2. Human, H-E stain, x 250.
- <u>17-09</u>. Young primary follicle 1. Human H-E stain, x 200.
- <u>17-10</u>. Young primary follicle 2. Human, epon section, toluidinblue stain, x 160.
- <u>17-11</u>. A little developed secondary follicle. Human, H-E stain, x 160
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- <u>17-13</u>. Graafian follicle 1. Monkey, H-E stain, x 25.
- <u>17-14</u>. Graafian follicle 2. Cumulus oophorus. Monkey, H-E stain, x 64.
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- <u>17-18</u>. Small Grafian follicle 3. Stratum granulosum, theca folliculi interna et externa. Human, M-G stain, x 160.

- <u>17-19</u>. Stratum granulosum, theca folliculi interna and externa. Monkey, H-E stain, x 100.
- <u>17-20</u>. Corpus rubrum 1. General view. Human, H-E stain, x 1.3.
- <u>17-21</u>. Corpus rubrum 2. Luteinization is less progressed. Human, H-E stain, x 25.
- 17-22. Corpus rubrum 3. Luteinization is not progressed. Human, H-E stain, x 160.
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- <u>17-24</u>. Corpus rubrum 5. Luteinization is progressed. Human, H-E stain, x 160.
- 17-25. Corpus luteum graviditatum 1. General view. Human, H-E stain, x 1.3.
- <u>17-26</u>. Corpus luteum graviditatum 2. General view. Human, H-E stain, x 10.
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- <u>17-28</u>. Corpus luteum menstruationis 1. General view. Human, H-E stain, x 1.15.
- 17-29. Corpus luteum menstruationis 2. Lutein cells 1. Human, H-E stain, x 25.
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- <u>17-31</u>. Granulosa lutein cells. Monkey, H-E stain, x 160.
- <u>17-32</u>. Corpus albicans 1. Human, H-E stain, x 4.0.
- 17-33. Corpus albicans 2. Human, Azan stain, x 25.
- <u>17-34</u>. Atretic follicle. Human, H-E stain, x 80.
- <u>17-35</u>. Ovary of a human embryo 1. General view. H-E stain, x 4.0.
- <u>17-36</u>. Ovary of a human embryo 2. H-E stain, x 64.



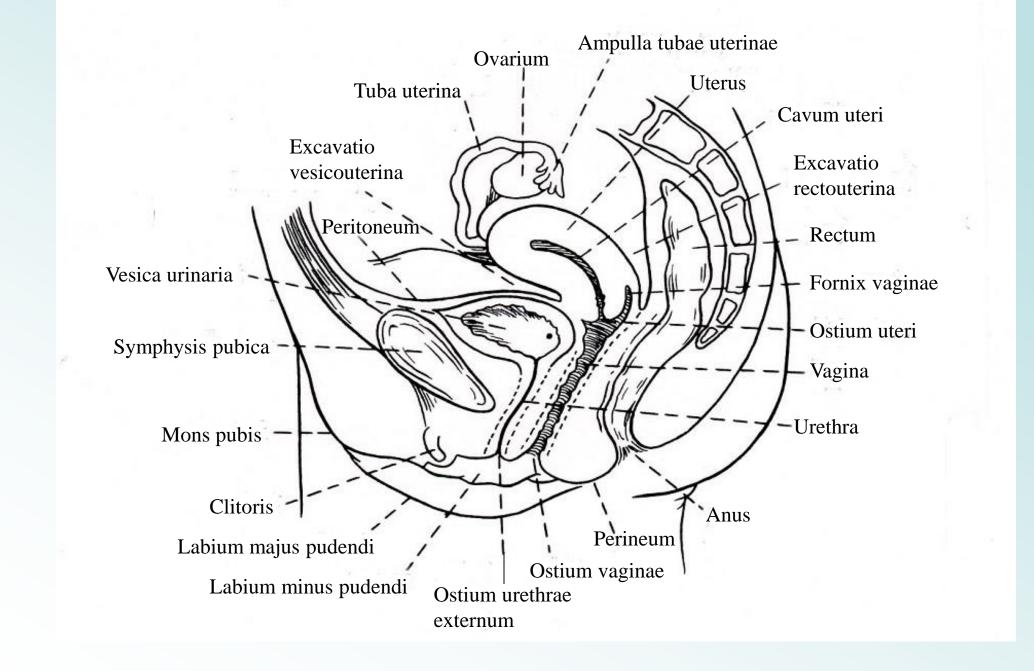
17 Female Reproductive System Menu 2/2

17-002. Oviduct

- <u>17-37</u>. Ostium abdominale tubae 1. General view. Monkey, H-E stain, x 2.0.
- <u>17-38</u>. Ostium abdominale tubae 2. General view. Human, H-E stain, x 2.4.
- <u>17-39</u>. Oviduct, transverse section. Human, H-E stain, x 5.0.
- <u>17-40</u>. Isthmus tubae, transverse section. Human, H-E stain, x 6.5.
- <u>17-41</u>. Epithelium of oviduct. Human, H-E stain, x 250.
- <u>17-003</u>. Uterus
- <u>17-42</u>. Uterus, transverse section. General view. Monkey, H-E stain, x 1.7.
- <u>17-43</u>. Scheme showing the interrelationship between ovary and endometrium.
- <u>17-44</u>. Endometrium on day 3 of menstrual cycle. Human, H-E stain, x 10.
- <u>17-45</u>. Endometrium on day 7 of menstrual cycle. Human, H-E stain, x 10.
- <u>17-46</u>. Endometrium on day 14 of menstrual cycle. Human, H-E stain, x 10.
- <u>17-47</u>. Endometrium on day 22 of menstrual cycle. Human, H-E stain, x 10.
- <u>17-48</u>. Endometrium on day 28 of menstrual cycle. Human, H-E stain, x 10.
- <u>17-49</u>. Superficial portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 25.
- <u>17-50</u>. Deeper portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 64.
- <u>17-51</u>. Superficial portion of endometrium on day 28 of menstrual cycle. Human, H-E stain, x 25.

- <u>17-52</u>. Cervical canal, longitudinal section. Human, H-E stain, x 1.2.
- 17-004. Vagina and Genitalia
- <u>17-53</u>. Anterior wall of vagina and urethra. Transverse section. Human, H-E stain, x 1.7.
- <u>17-54</u>. Epithelium of vagina. Human. H-E stain, x 64.
- <u>17-55</u>. Clitoris, longitudinal section. Human, H-E stain, x 3.0.
- <u>17-56</u>. Genital corpuscle. Human, H-E stain, x 100.
- <u>17-57</u>. Labium minus pudendi. Transverse section. H-E stain, x 4.0.
- <u>17-005</u>. Placenta
- <u>17-58</u>. Scheme showing the development of placenta 1.
- <u>17-59</u>. Scheme showing the development ofplacenta.
- <u>17-60</u>. Placenta on day 51 of gestation 1. Human, H-E stain, x 1.5.
- <u>17-61</u>. Placenta on day 51 of gestation 2. Human, H-E stain, x 13.
- <u>17-62</u>. Placenta on day 51 of gestation 3. Transverse section of a villus. Human, H-E stain, x 200.
- <u>17-63</u>. Placenta after delivery 1. Human, H-E stain, x 25.
- <u>17-64</u>. Placenta after delivery 2. Human, H-E stain, x 64.
- <u>17-65</u>. Placenta after delivery 3. Human, H-E stain, x 400.
- 17-006. Mammary Gland
- <u>17-66</u>. Nipple and mammary glands, longitudinal section. Human, H-E stain, x 0.7.
- <u>17-67</u>. Nipple, longitudinal section. Human, H-E stain, x 4.0.
- 17-68. Mammary gland 1. Resting stage. Human, H-E stain, x 25.
- <u>17-69</u>. Mammary gland at term 1. Human, H-E stain, x 2.5.
- <u>17-70</u>. Mammary gland at term 2. Human, H-E stain, x 25.
- <u>17-71</u>. Mammary gland at term 3. Human, H-E stain, x 100.





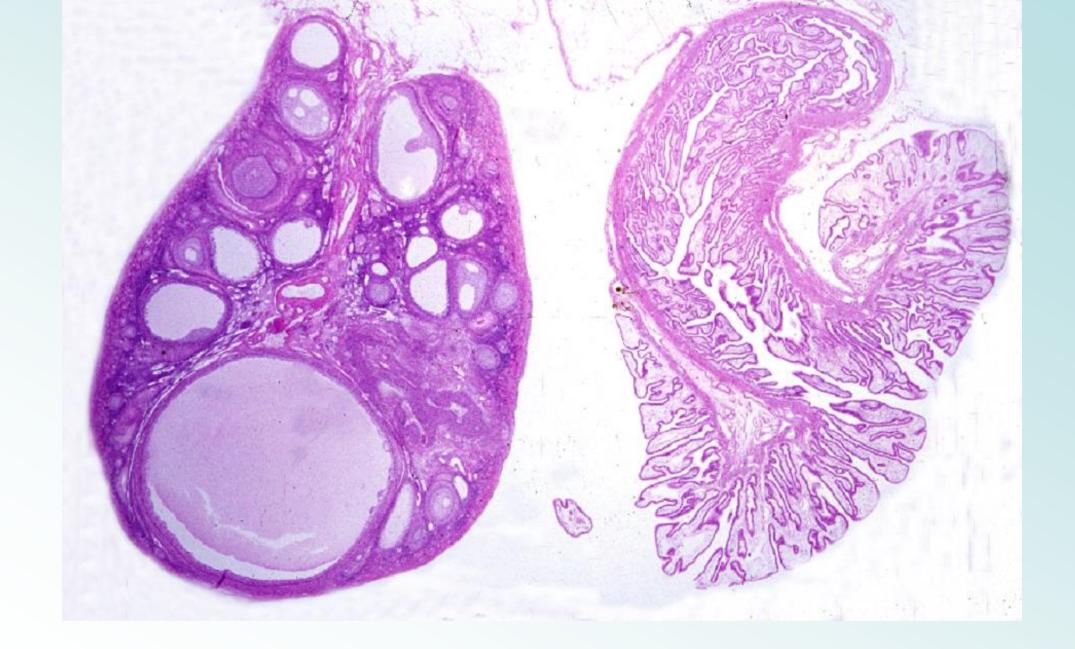
17-01 Scheme showing the female reproductive System.



17-001 Ovary

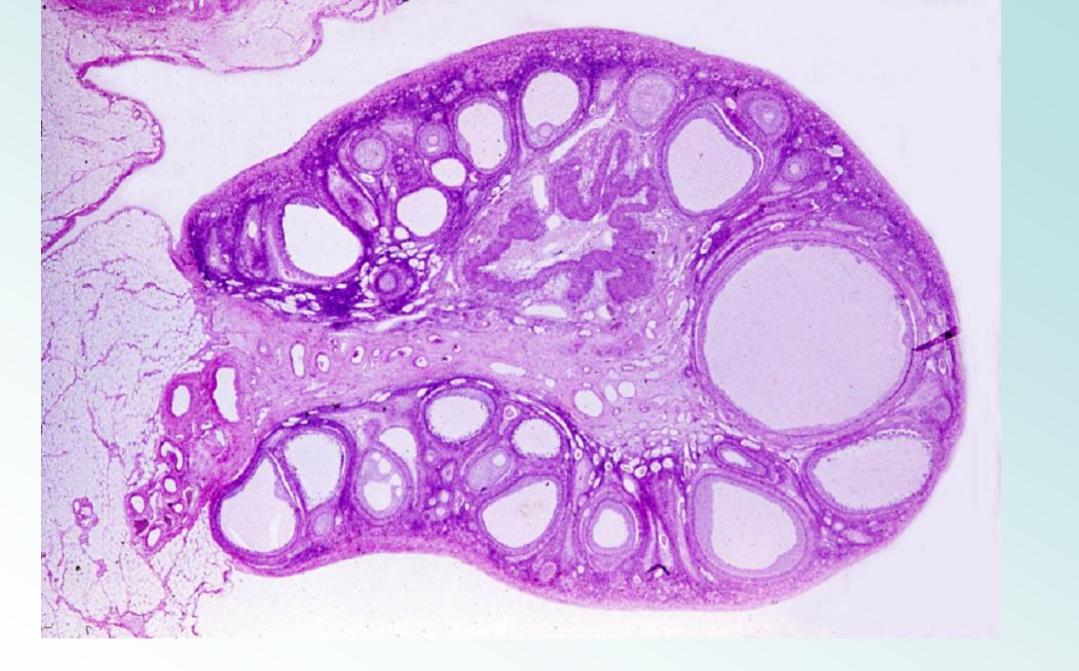
17-001 Ovary





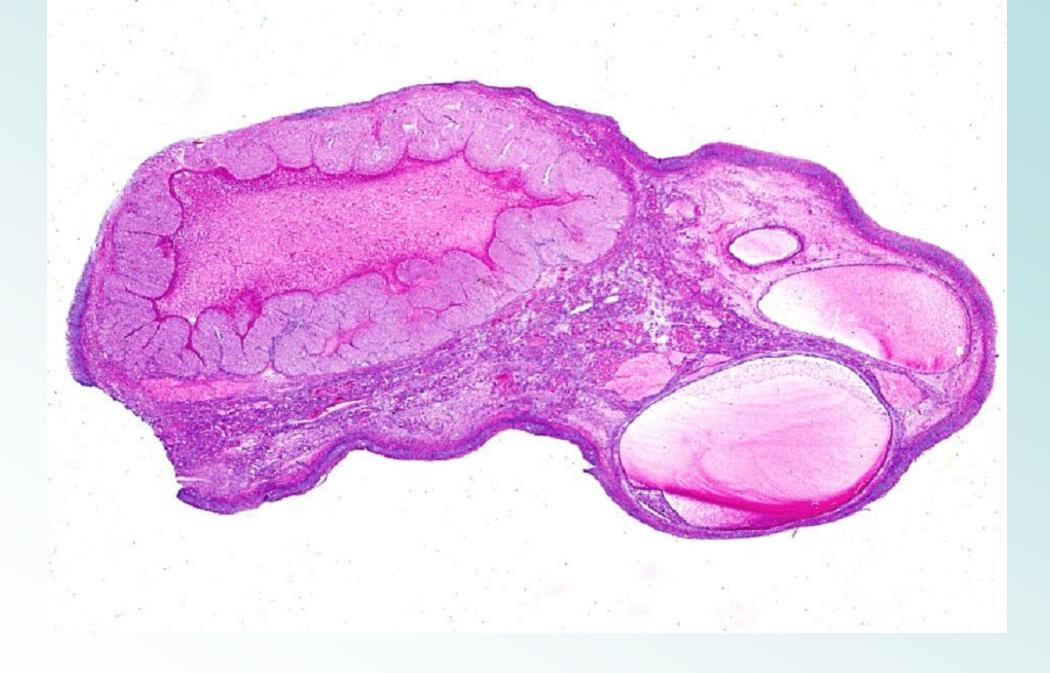
17-02 Ovary and oviduct. General view. Monkey, H-E stain, x 1.2.





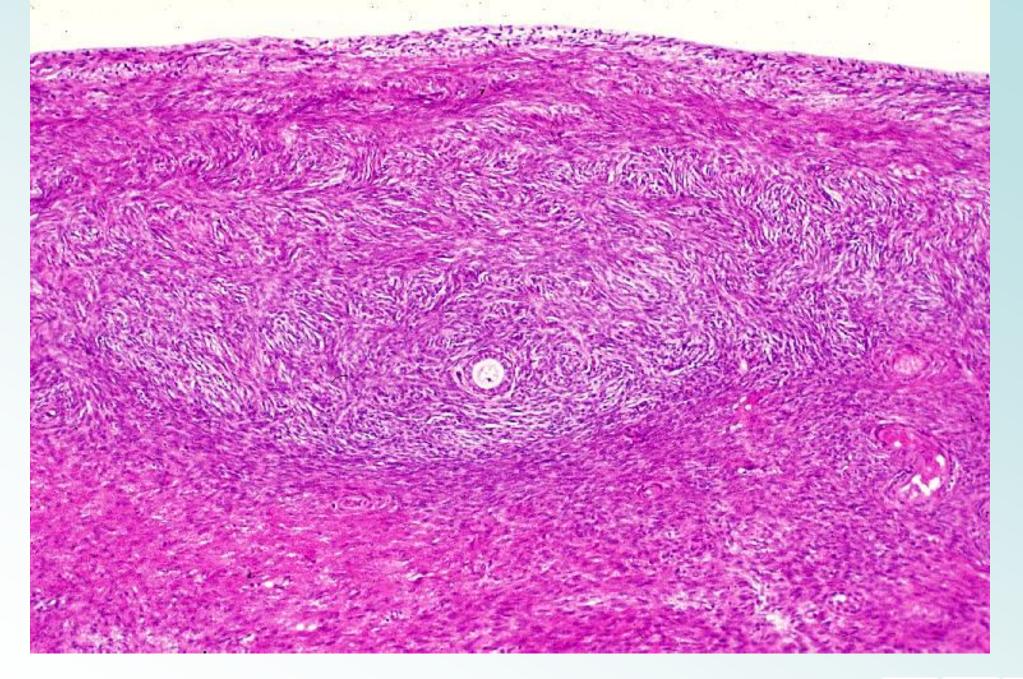
17-03 Overy Sagitall section, general view. Monkey, H-E stain, x 2.0.





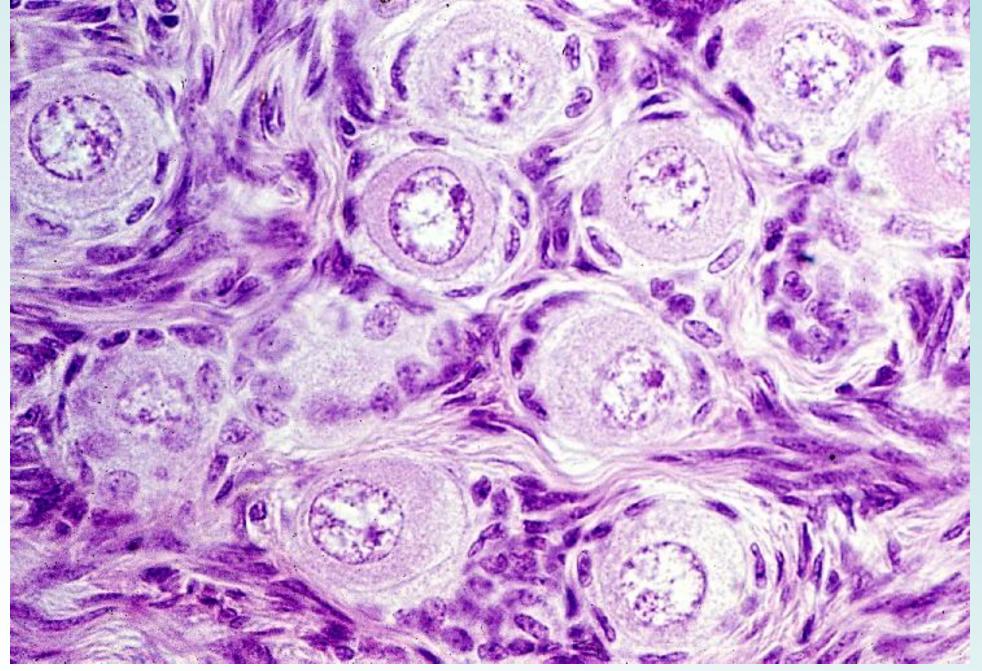
17-04 Ovary containing a large corpus luteum. Human, H-E stain, x 1.15.





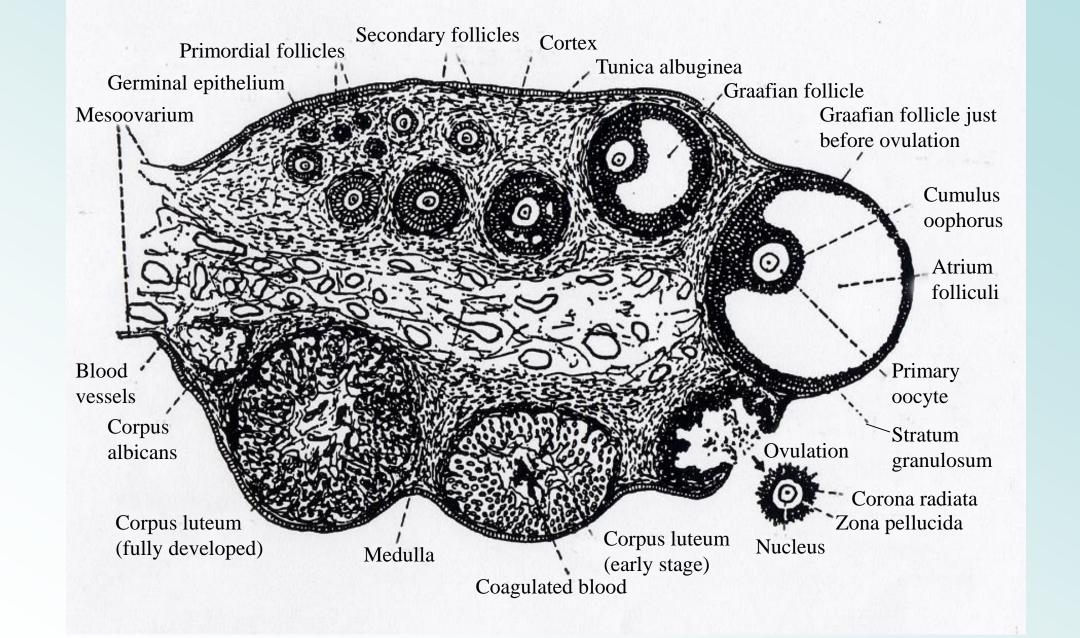
17-05 Cortex of ovary. Human, H-E attain, x 25.





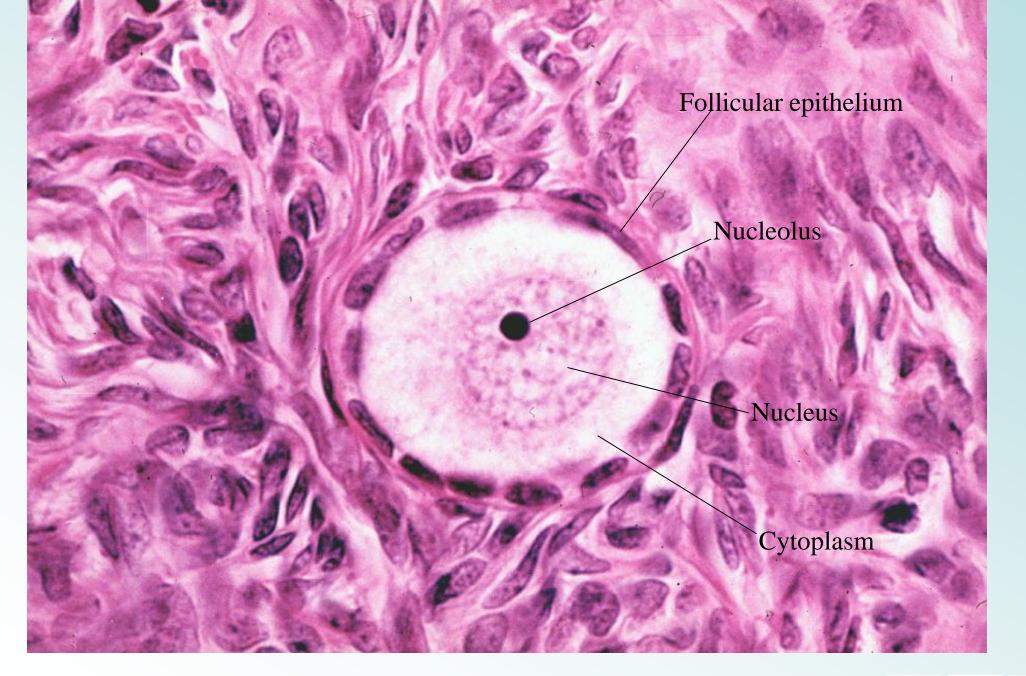
17-06 Primordial egg follicles 1. Monkey, H-E stain, x 160.





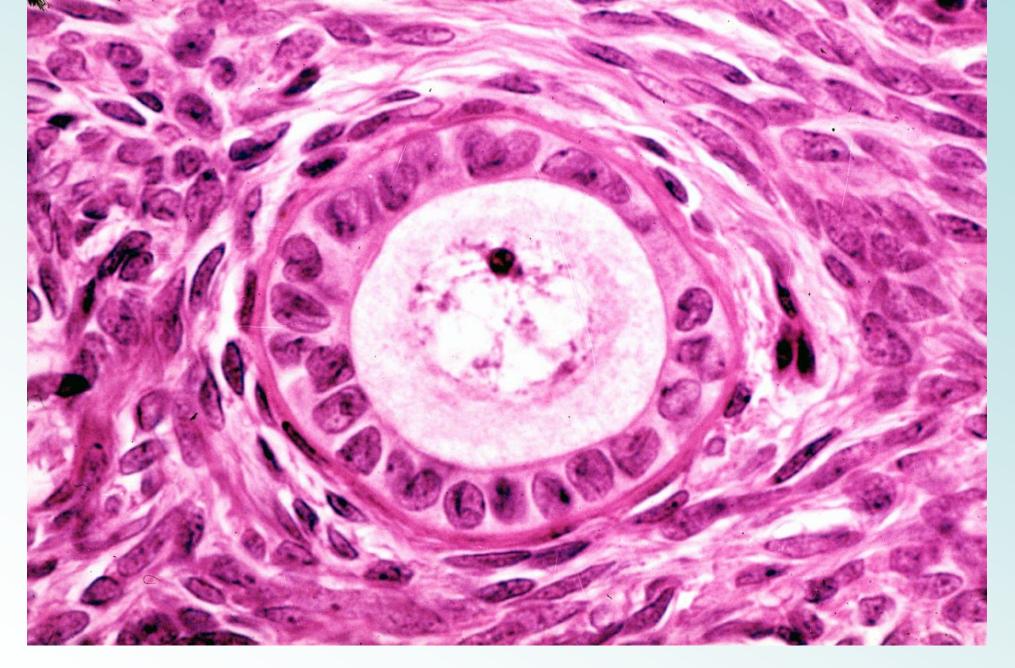
17-07 Scheme showing the development of egg follicles and corpus luteum.





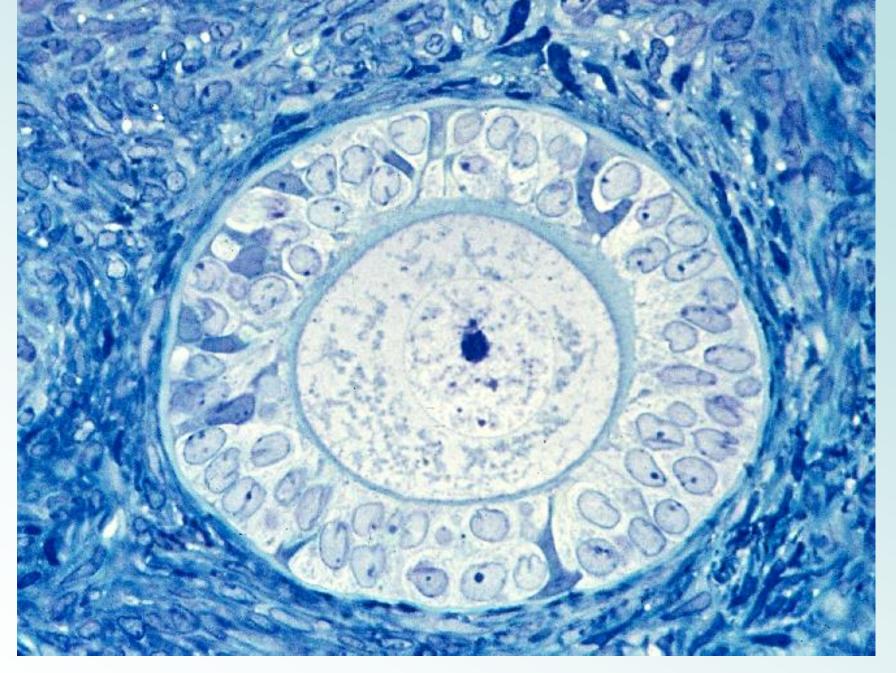
17-08 Primordial egg follicle 2. Human, H-E stain, x 250.





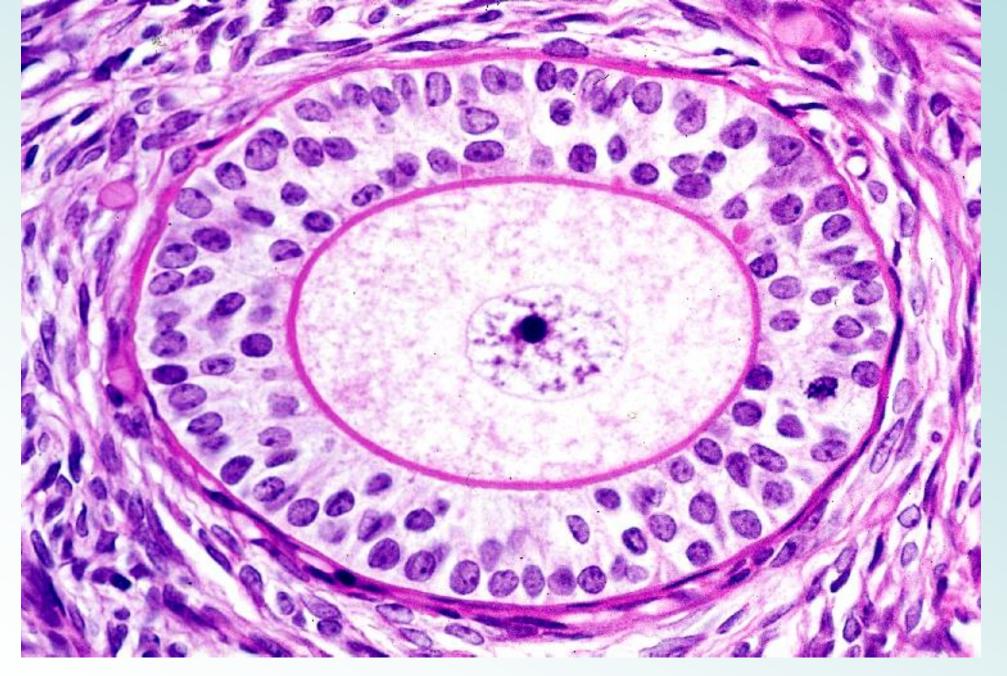
17-09 Young primary follicle 1. Human H-E stain, x 200.





17-10 Young primary follicle 2. Human, epon section, toluidinblue stain, x 160.





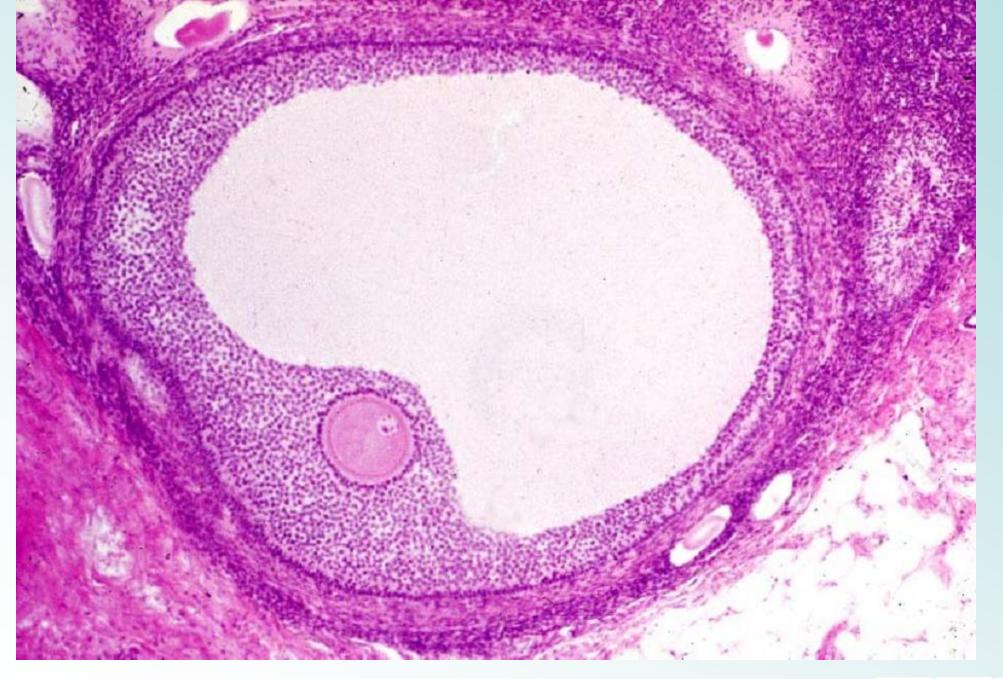
17-11 A little developed secondary follicle. Human, H-E stain, x 160





17-12 Well developed primary follicle. Human, H-E stain, x 100.





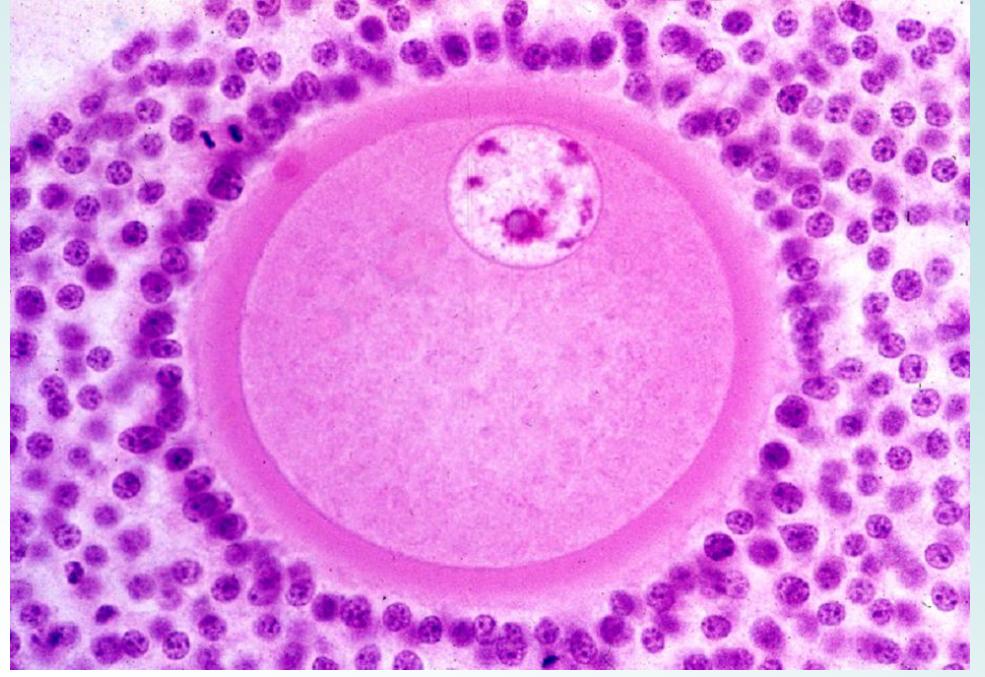
17-13 Graafian follicle 1. Monkey, H-E stain, x 25.





17-14 Graafian follicle 2. Cumulus oophorus. Monkey, H-E stain, x 64.





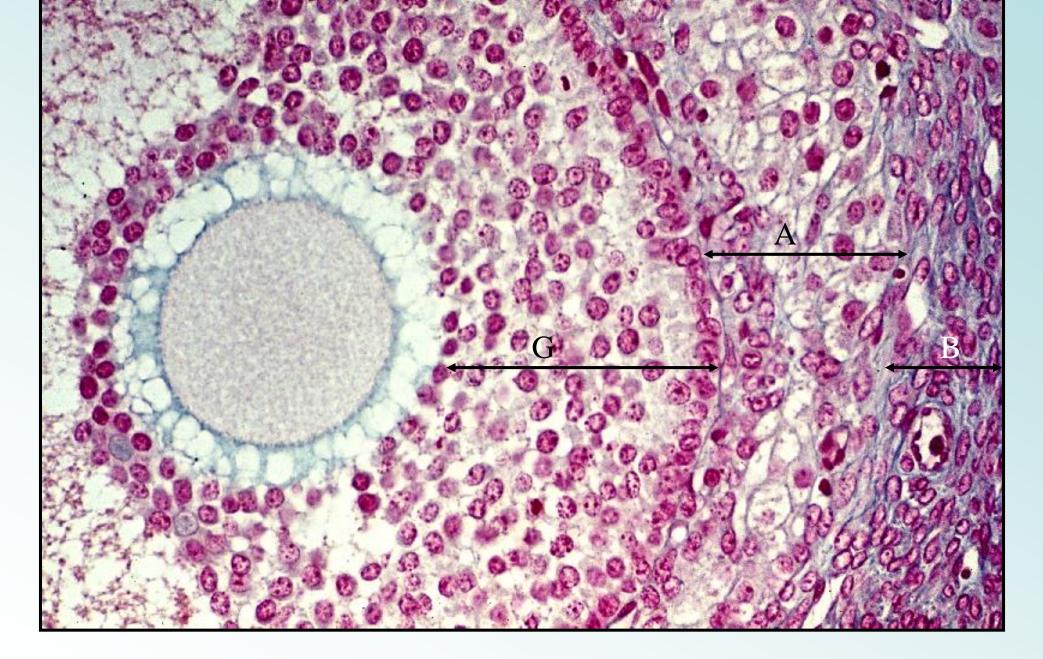
17-15 Oocyte in the cumulus oophorus. Monkey, H-E stain, x 200.





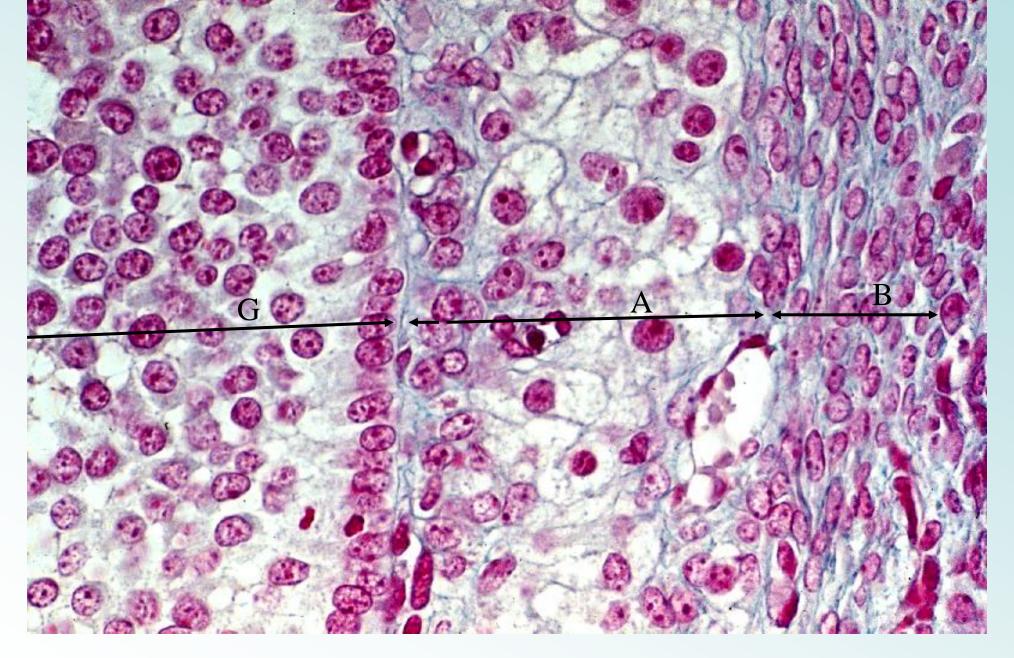
17-16 Small Graafian follicle 1. Human, M-G stain, x 40.





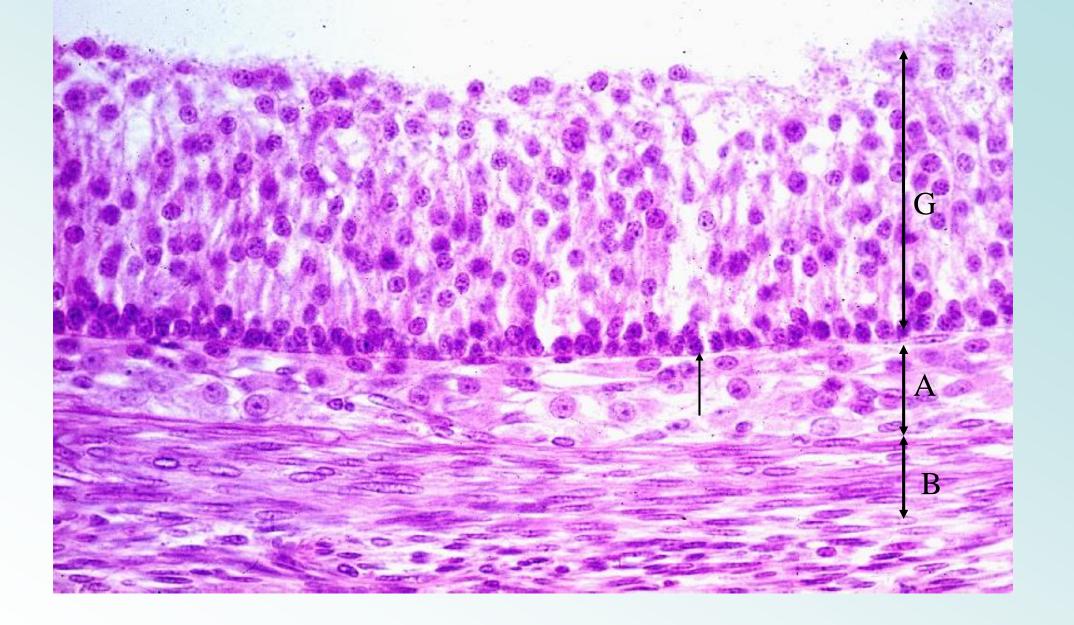
17-17 Small Graafian follicle 2. Human, M-G stain, x 100.





17-18 Small Grafian follicle 3. Stratum granulosum, theca folliculi interna et externa. Human, M-G stain, x 160.



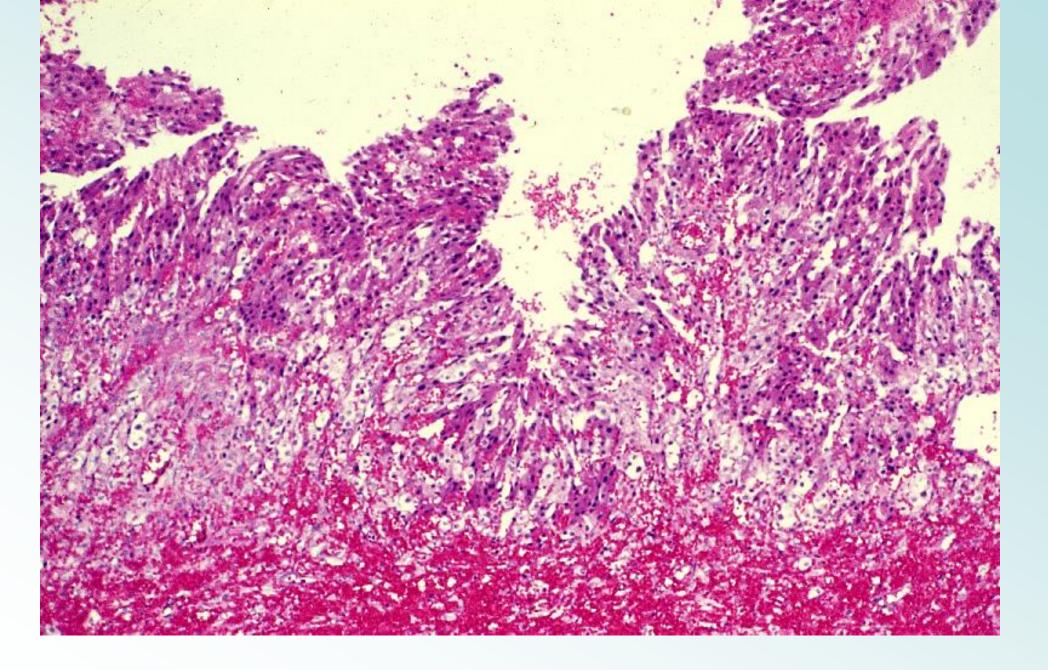


17-19 Stratum granulosum, theca folliculi interna and externa. Monkey, H-E stain, x 100. 📁 Meru 🕼 Meru 🦃 Back 📫 👘 Next



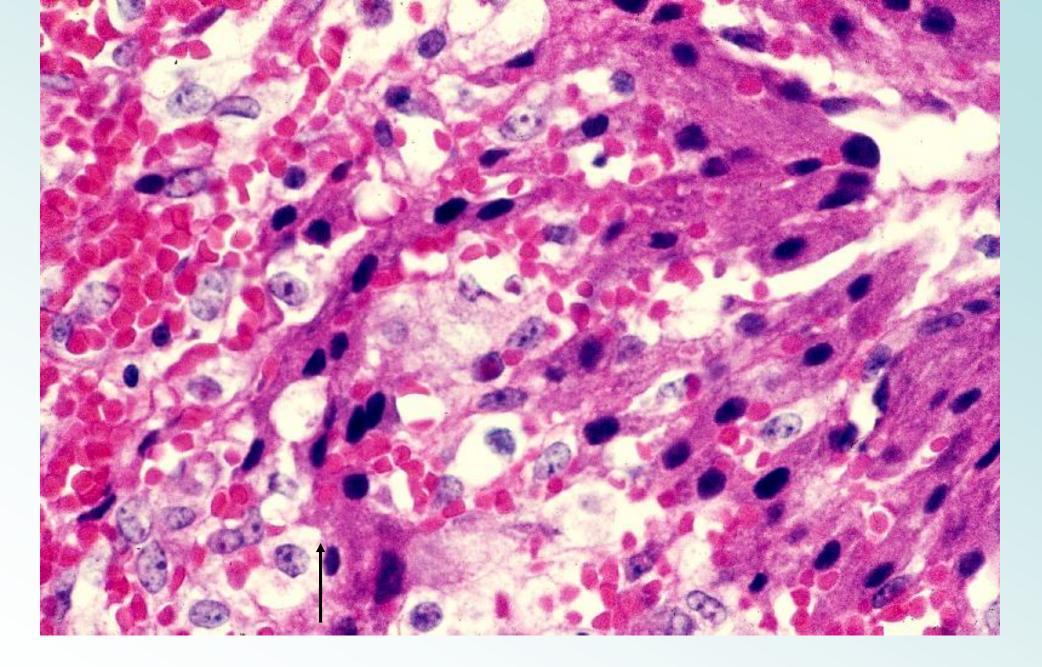
17-20 Corpus rubrum 1. General view. Human, H-E stain, x 1.3.





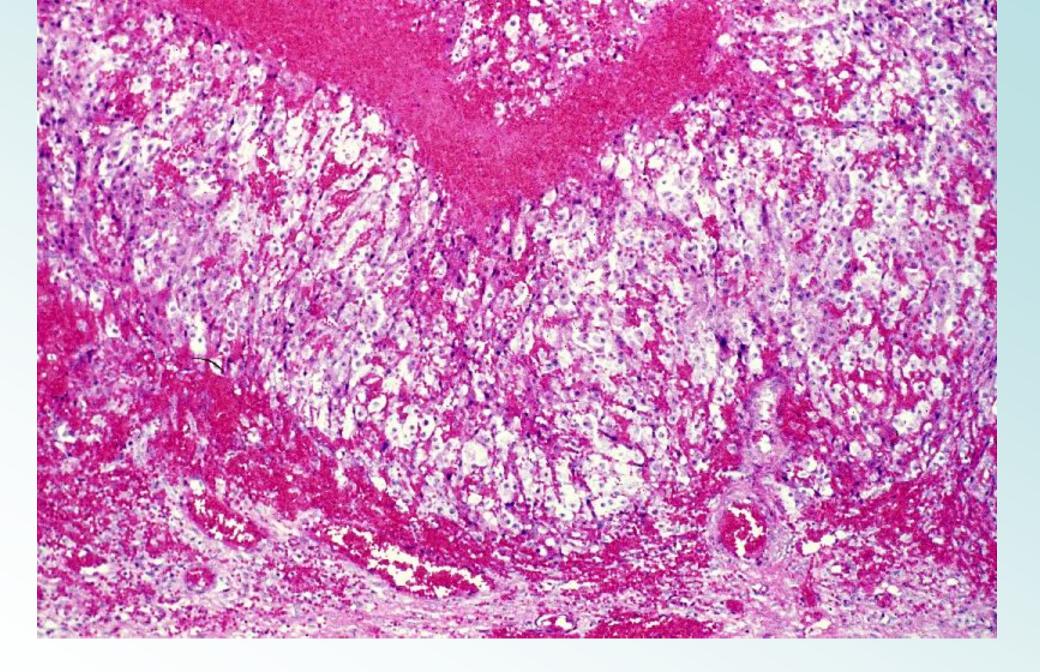
17-21 Corpus rubrum 2. Luteinization is less progressed. Human, H-E stain, x 25.





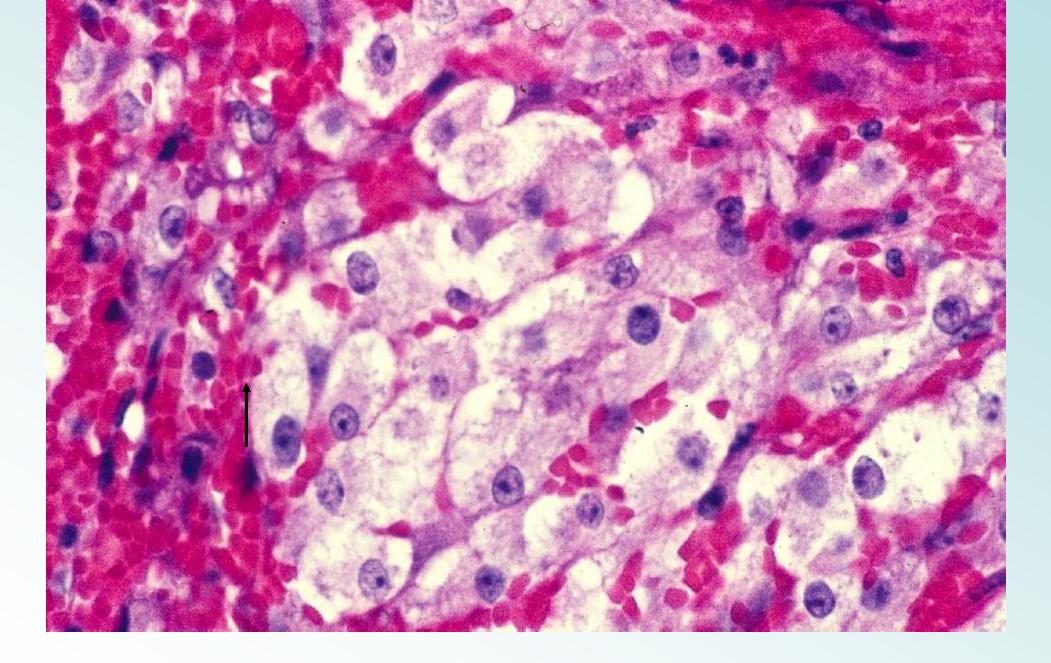
17-22 Corpus rubrum 3. Luteinization is not progressed. Human, H-E stain, x 160.





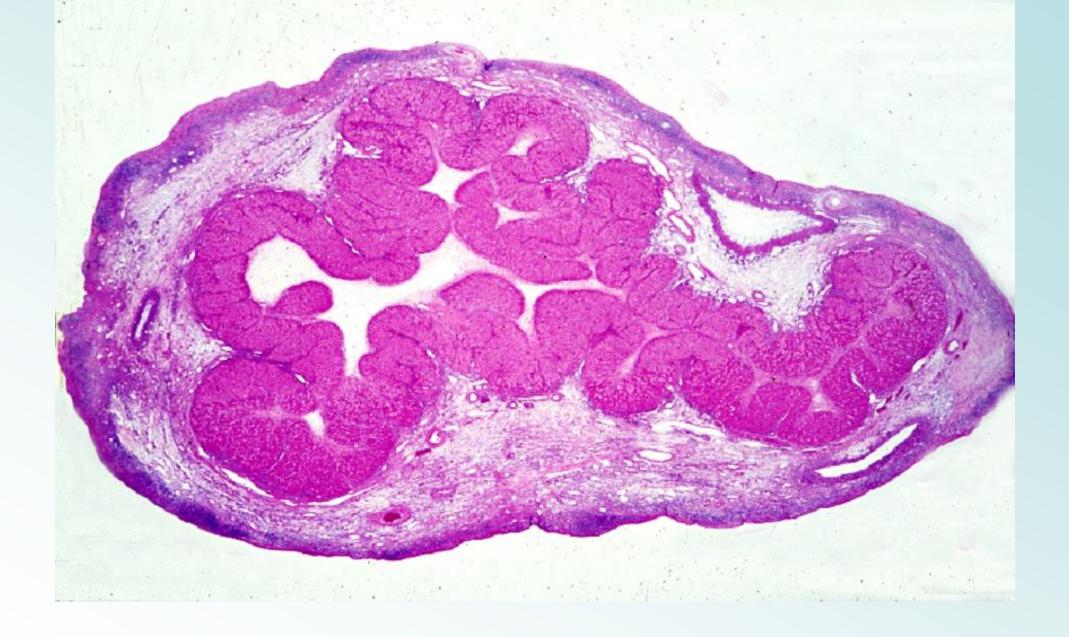
17-23 Corpus rubrum 4. Luteinization is progressed. Human, H-E stain, x 25.





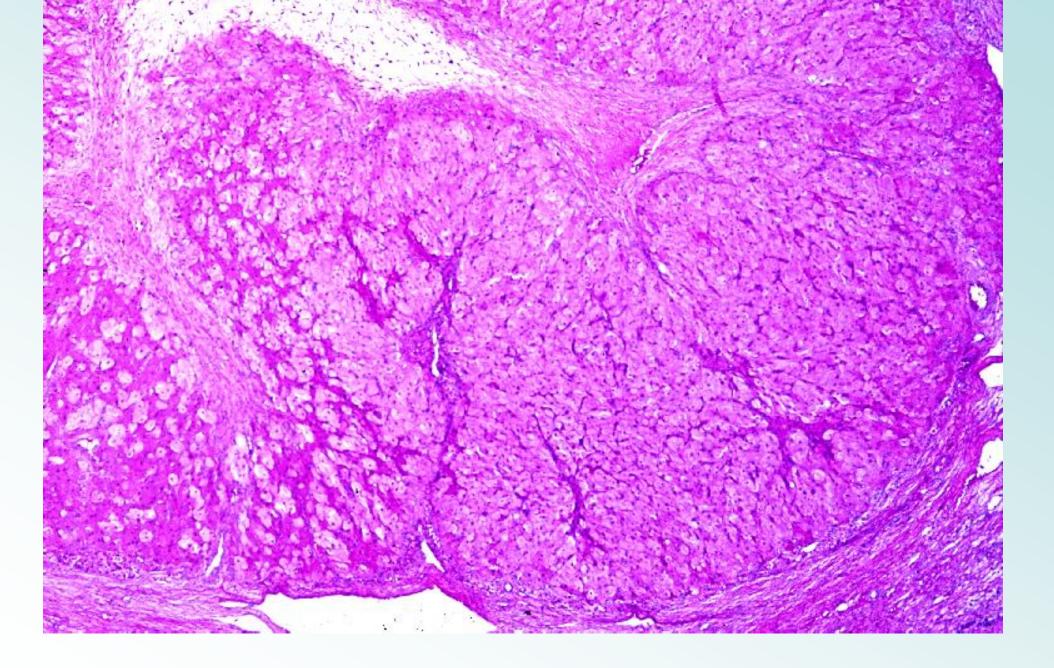
17-24 Corpus rubrum 5. Luteinization is progressed. Human, H-E stain, x 160.





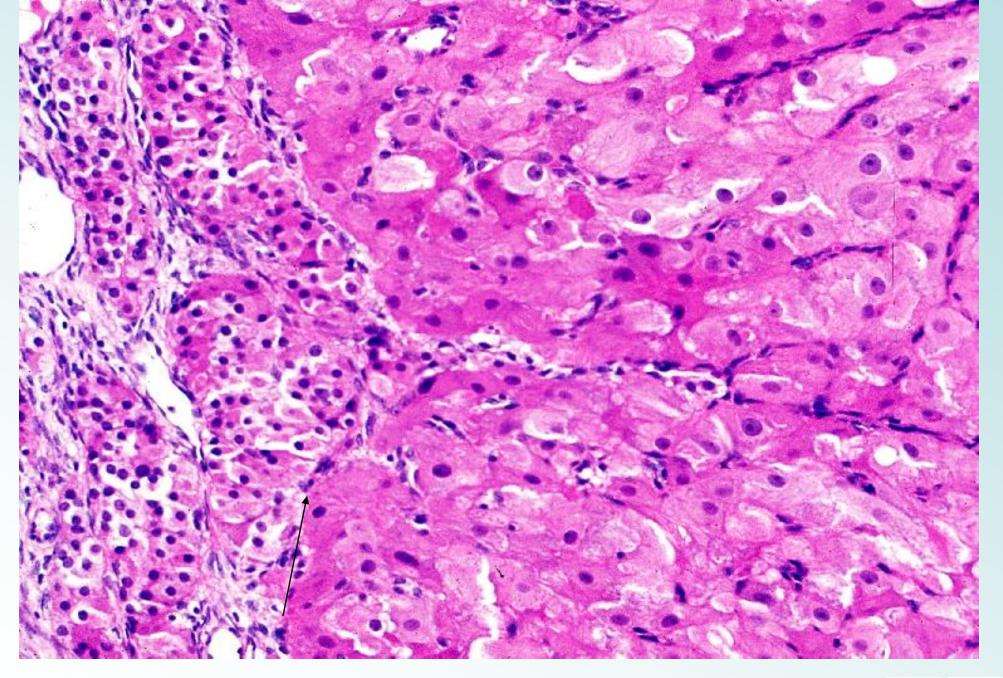
17-25 Corpus luteum graviditatum 1. General view. Human, H-E stain, x 1.3.





17-26 Corpus luteum graviditatum 2. General view. Human, H-E stain, x 10.





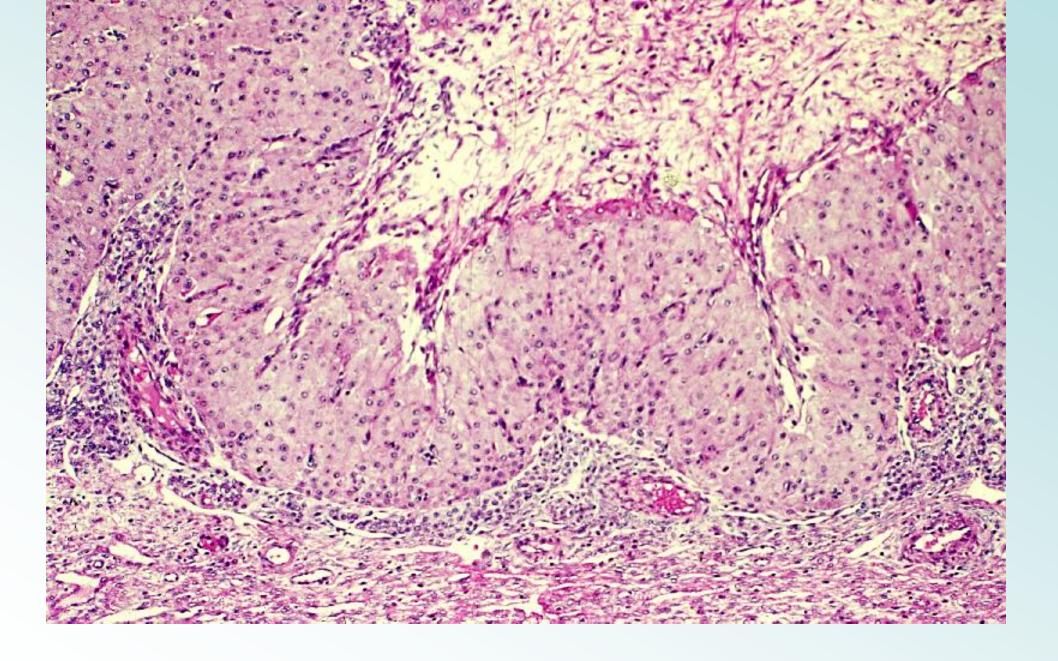
17-27 Corpus luteum graviditatum 3. Lutein cells. Human, H-E stain, x 64.





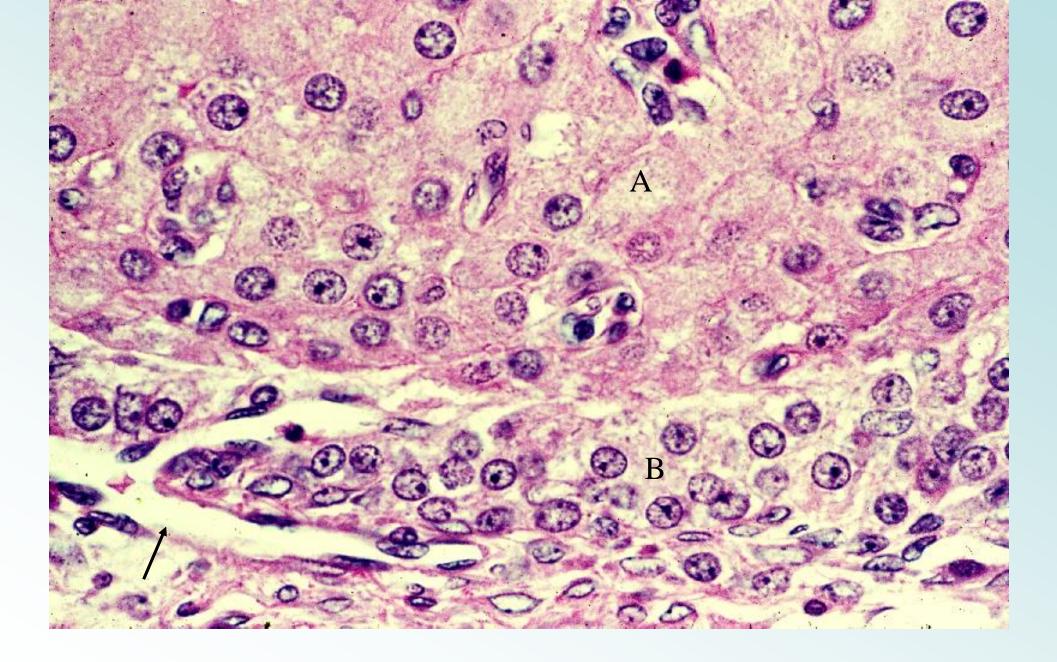
17-28 Corpus luteum menstruationis 1. General view. Human, H-E stain, x 1.15.





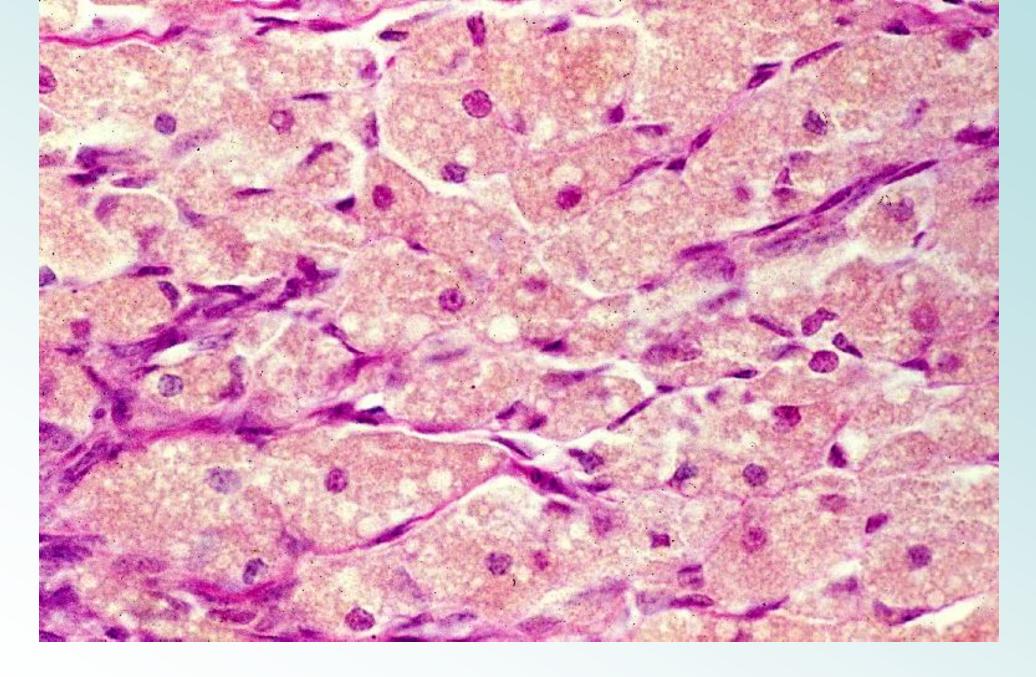
17-29 Corpus luteum menstruationis 2. Lutein cells 1. Human, H-E stain, x 25.





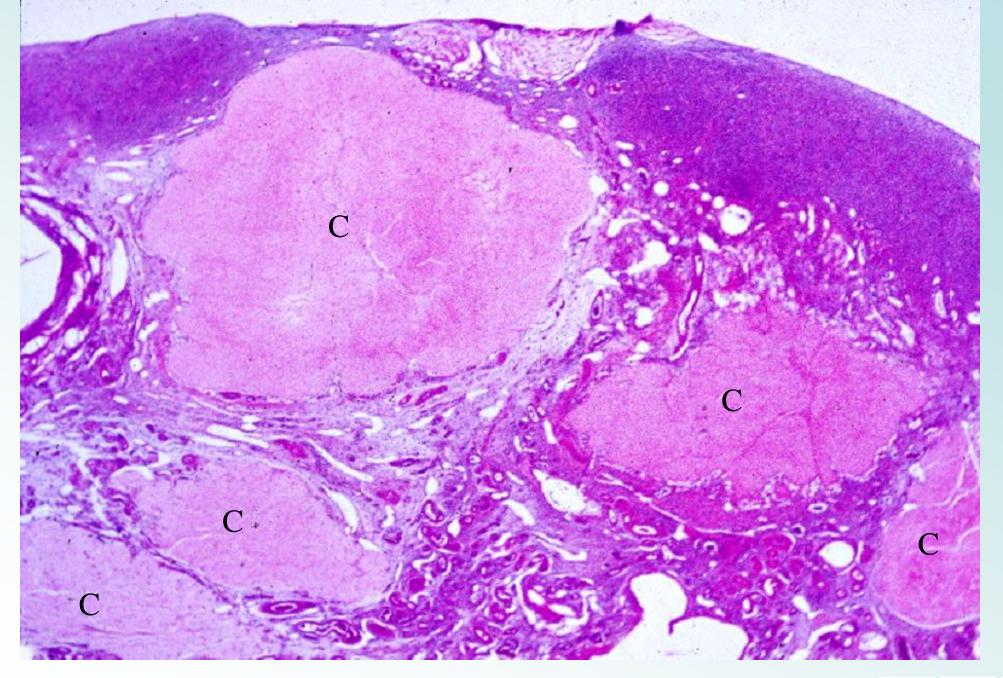
17-30 Corpus luteum menstruationis 3. Lutein cells 2. Human, H-E stain, x 160.





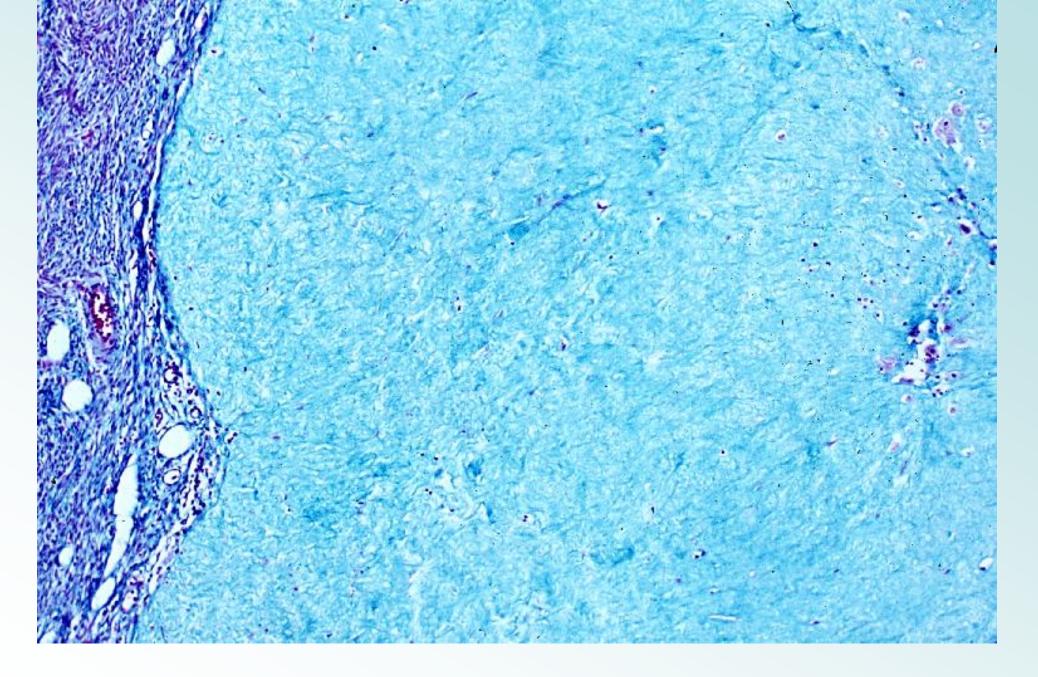
17-31 Granulosa lutein cells. Monkey, H-E stain, x 160.





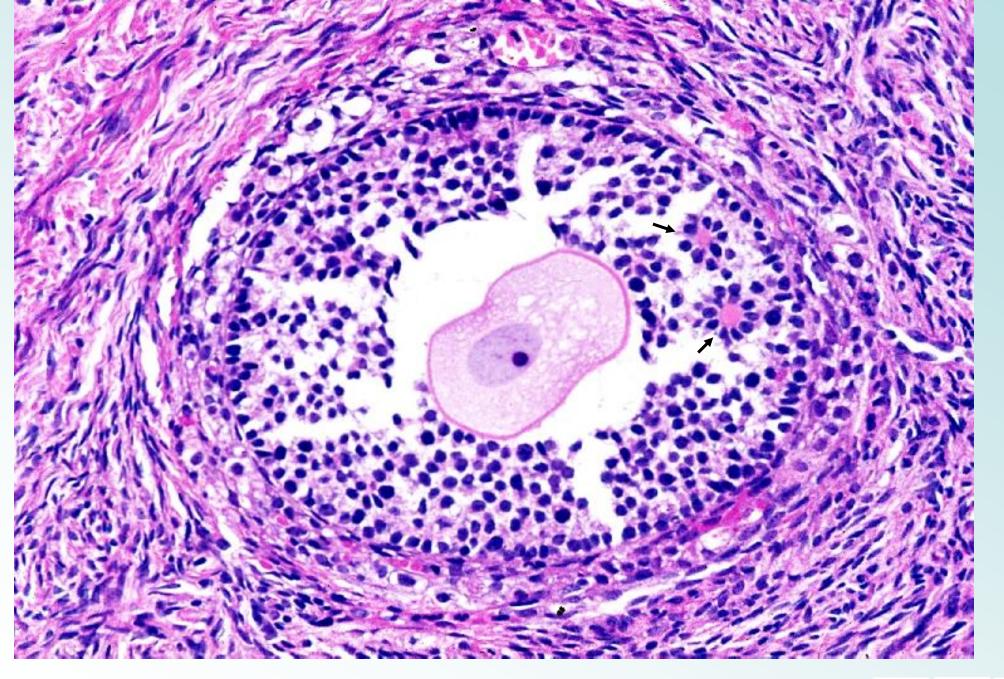
17-32 Corpus albicans 1. Human, H-E stain, x 4.0.





17-33 Corpus albicans 2. Human, Azan stain, x 25.





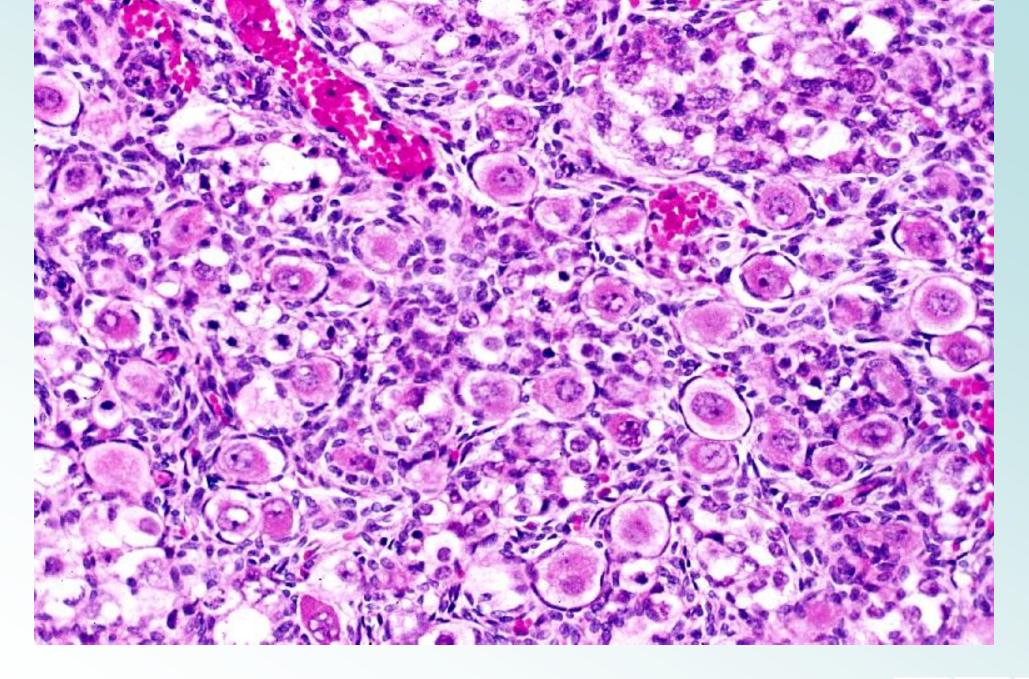
17-34 Atretic follicle. Human, H-E stain, x 80.





17-35 Ovary of a human embryo 1. General view. H-E stain, x 4.0.





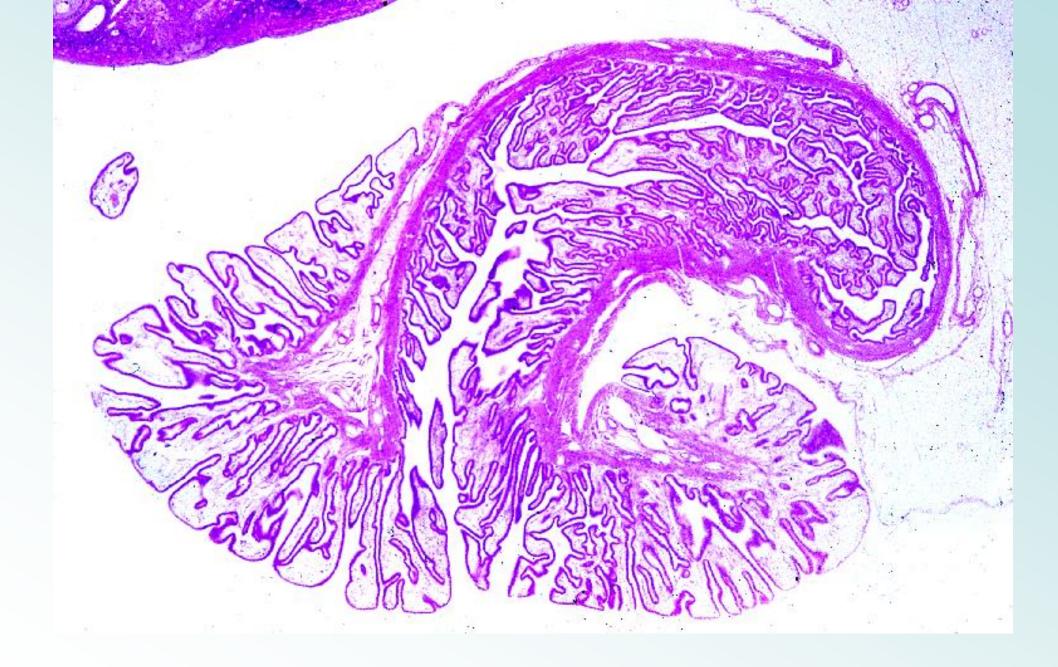
17-36 Ovary of a human embryo 2. H-E stain, x 64.



17-002 Oviduct

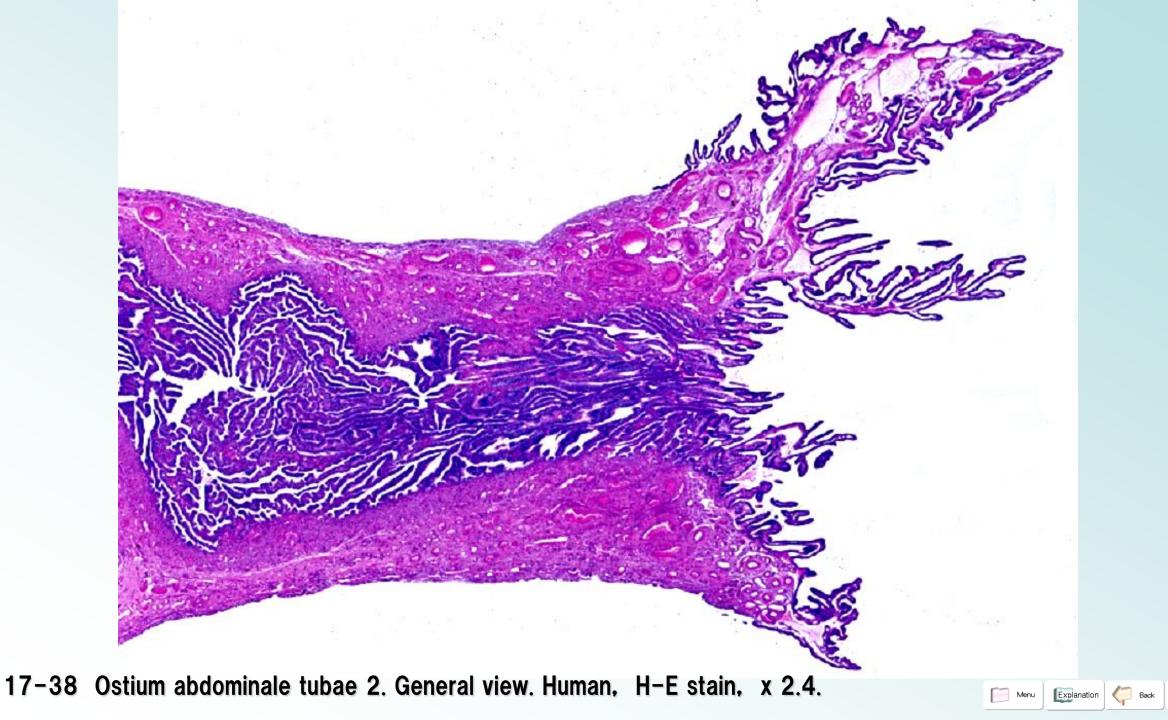
17-002 Oviduct



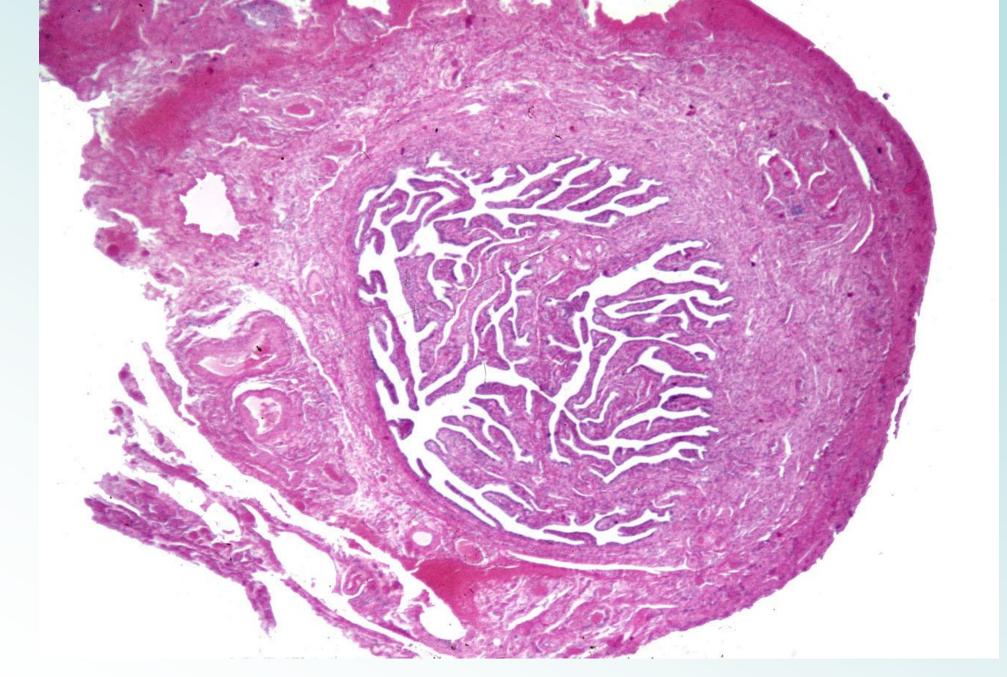


17-37 Ostium abdominale tubae 1. General view. Monkey, H-E stain, x 2.0.





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17-39 Oviduct, transverse section. Human, H-E stain, x 5.0.





17-40 Isthmus tubae, transverse section. Human, H-E stain, x 6.5.





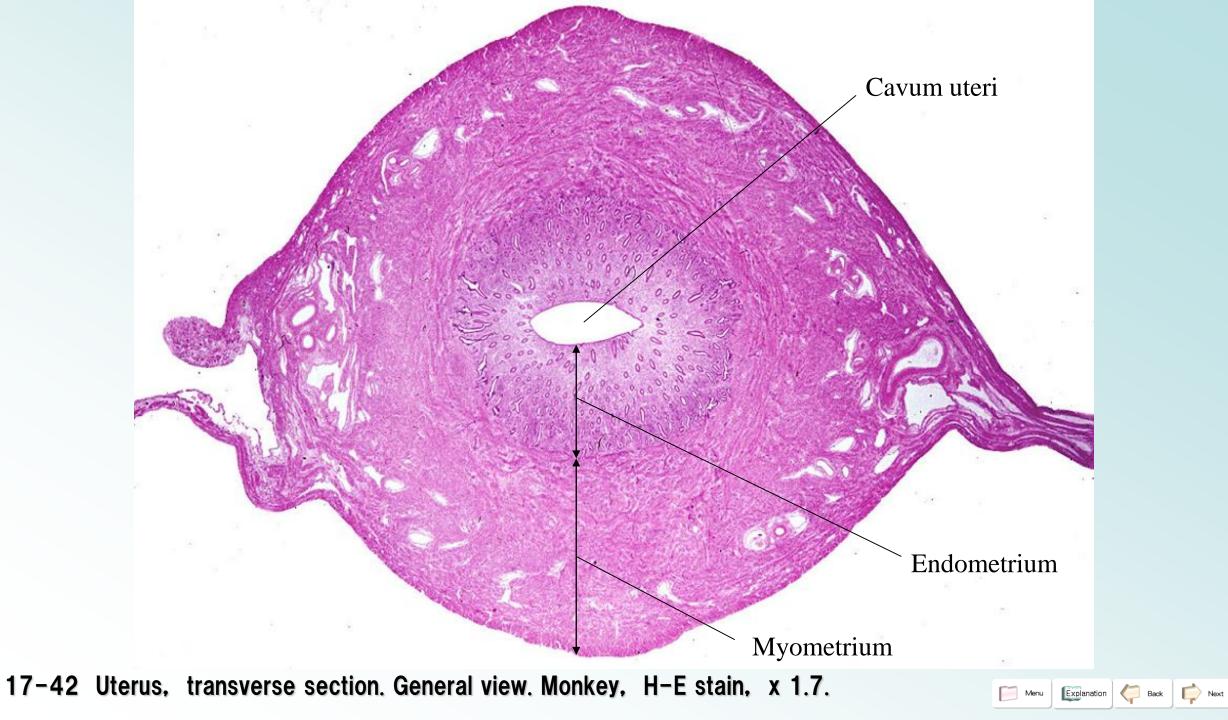
17-41 Epithelium of oviduct. Human, H-E stain, x 250.

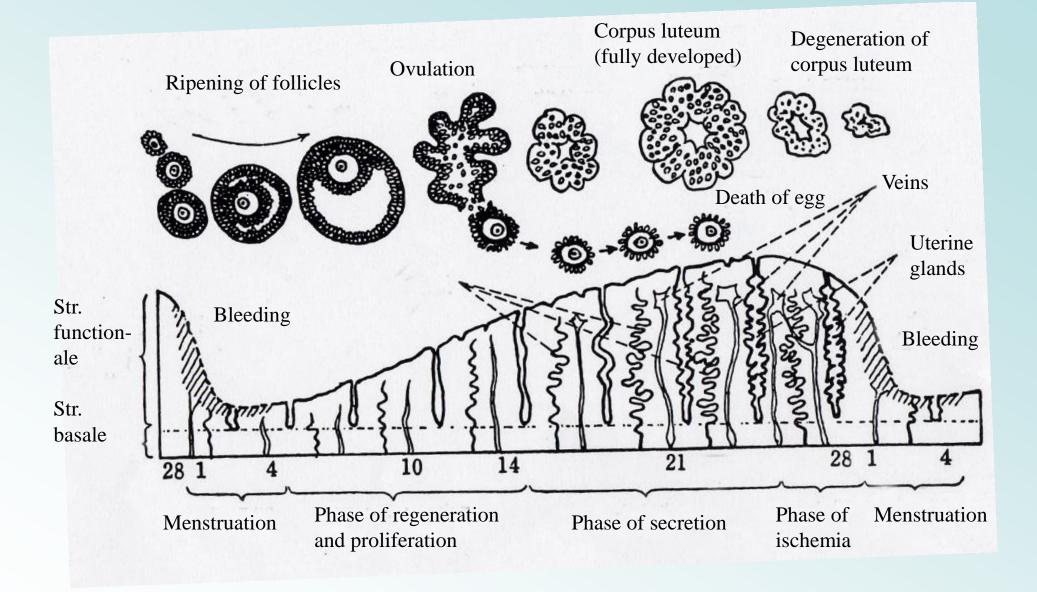


17-003 Uterus

17-003 Uterus







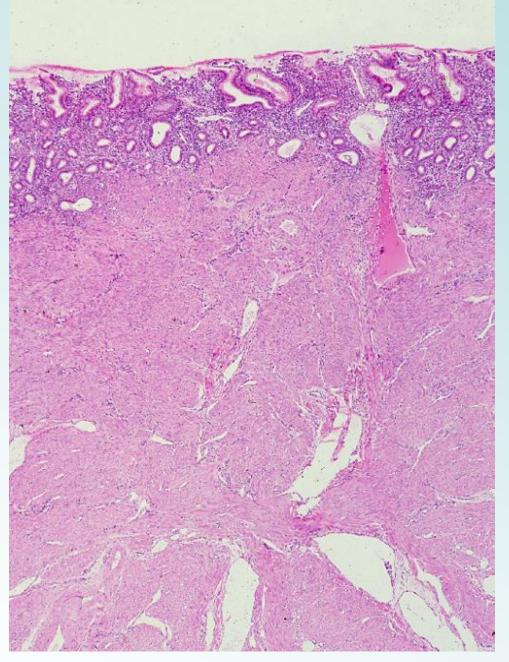
Menu

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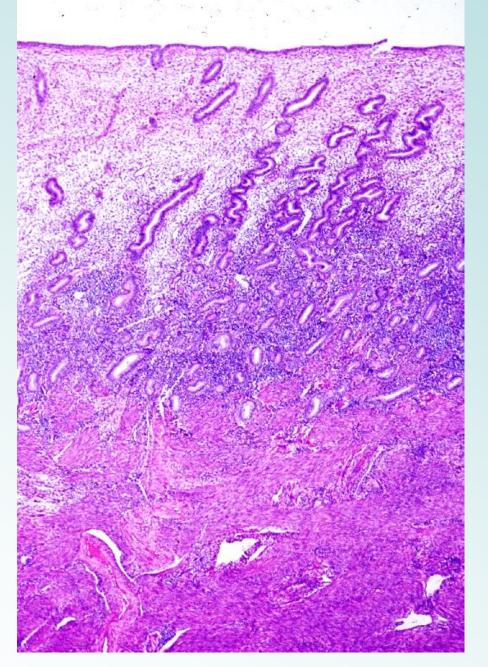
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17-43 Scheme showing the interrelationship between ovary and endometrium.



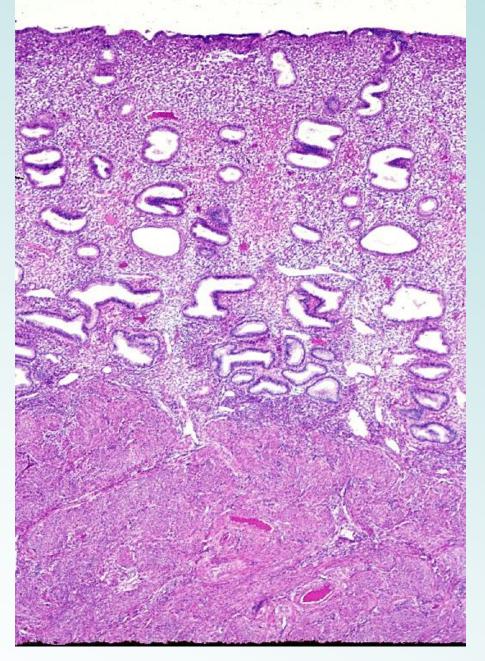
17-44 Endometrium on day 3 of menstrual cycle. Human, H-E stain, x 10.





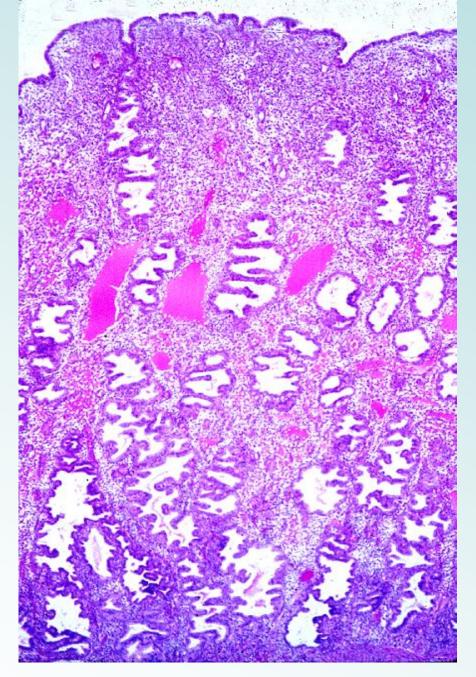
17-45 Endometrium on day 7 of menstrual cycle. Human, H-E stain, x 10.





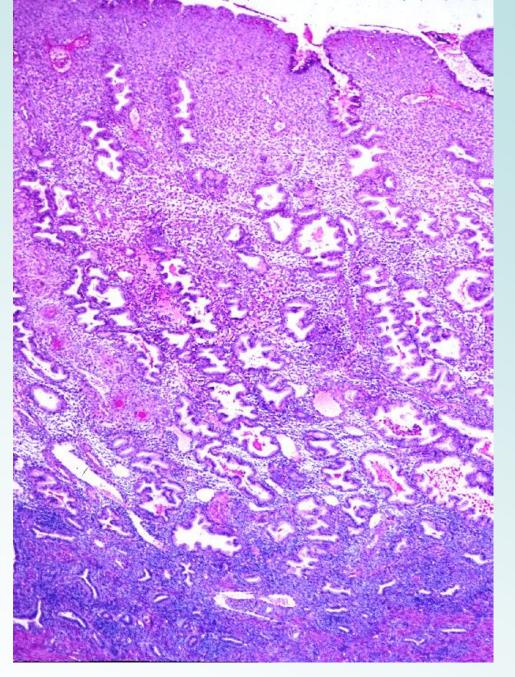
17-46 Endometrium on day 14 of menstrual cycle. Human, H-E stain, x 10.





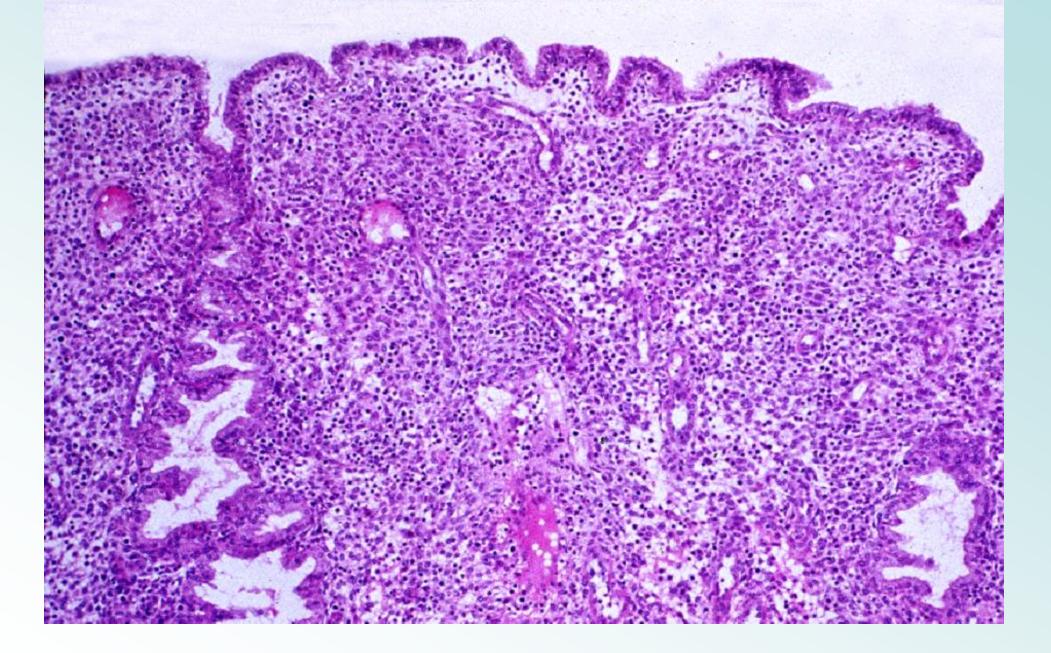
17-47 Endometrium on day 22 of menstrual cycle. Human, H-E stain, x 10.





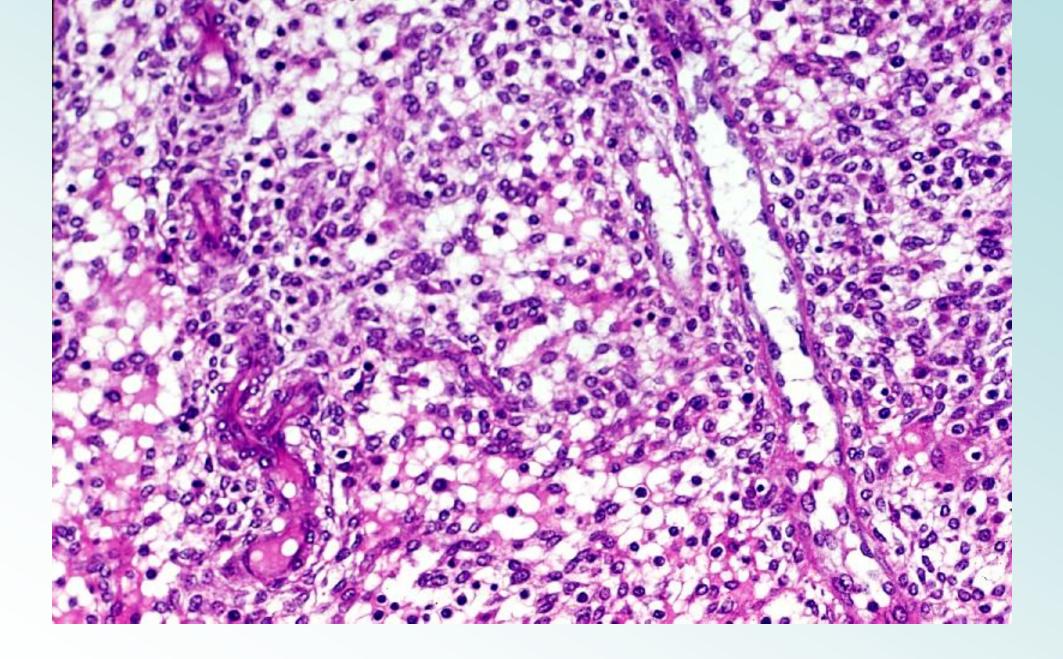
17-48 Endometrium on day 28 of menstrual cycle. Human, H-E stain, x 10.



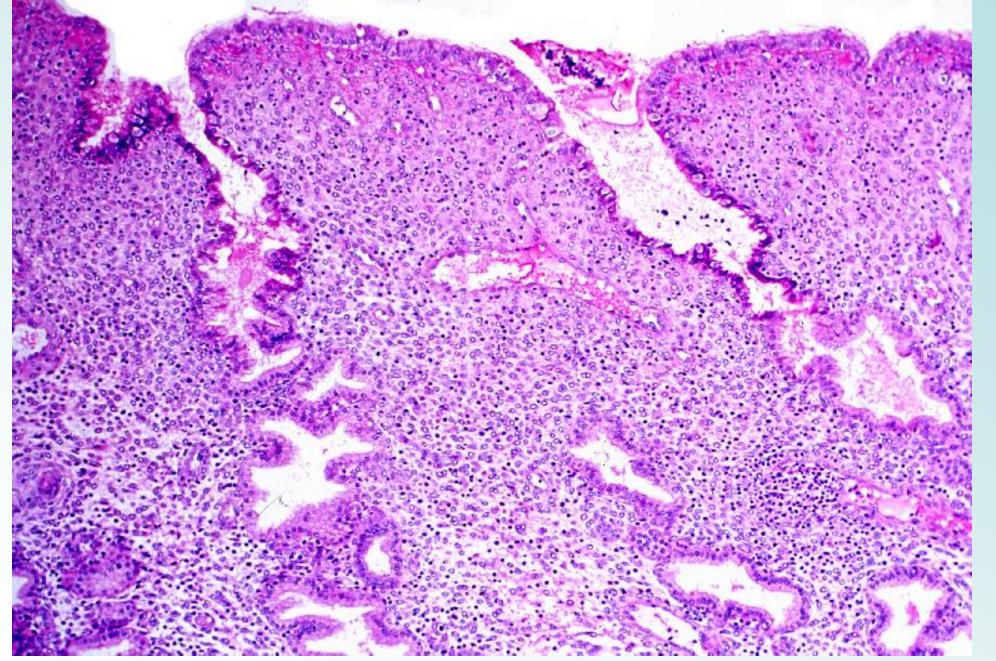


17-49 Superficial portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 25.



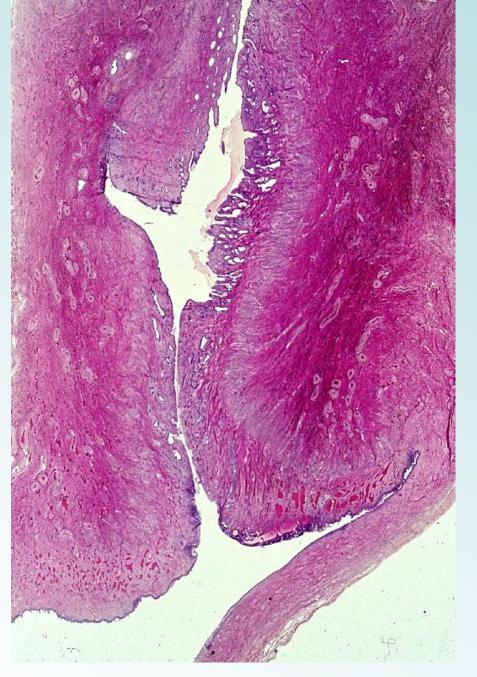


17-50 Deeper portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 64. 🖻 Meru 🖾 anator 🦨 Meru 👘 Meru



17-51 Superficial portion of endometrium on day 28 of menstrual cycle. Human, H-E stain, x 25.





17-52 Cervical canal, longitudinal section. Human, H-E stain, x 1.2.

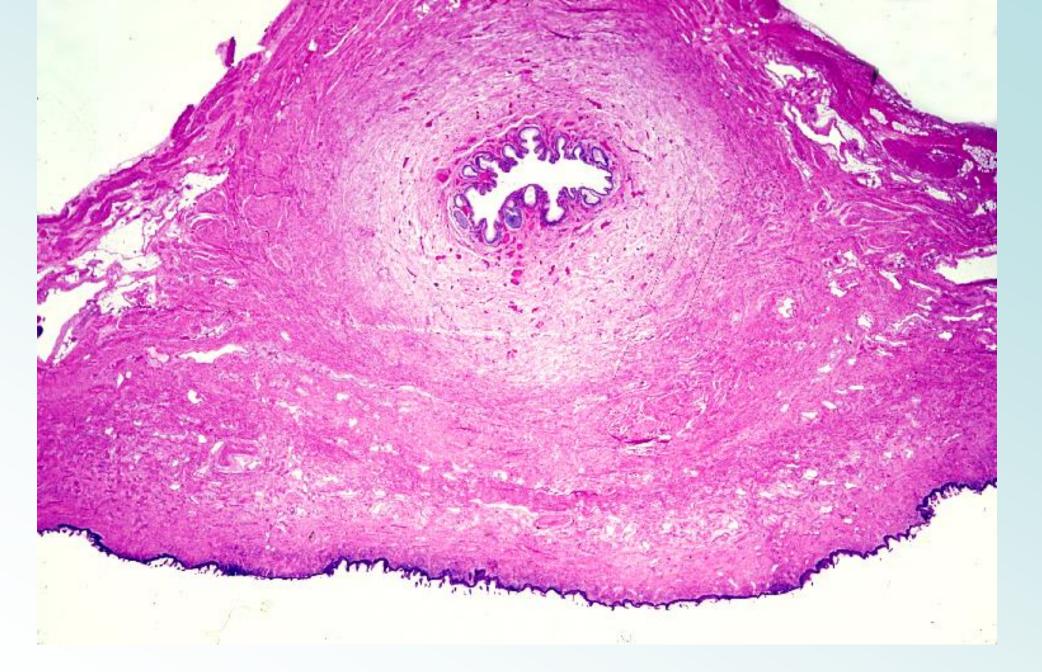


17-004 Vagina and Genitalia

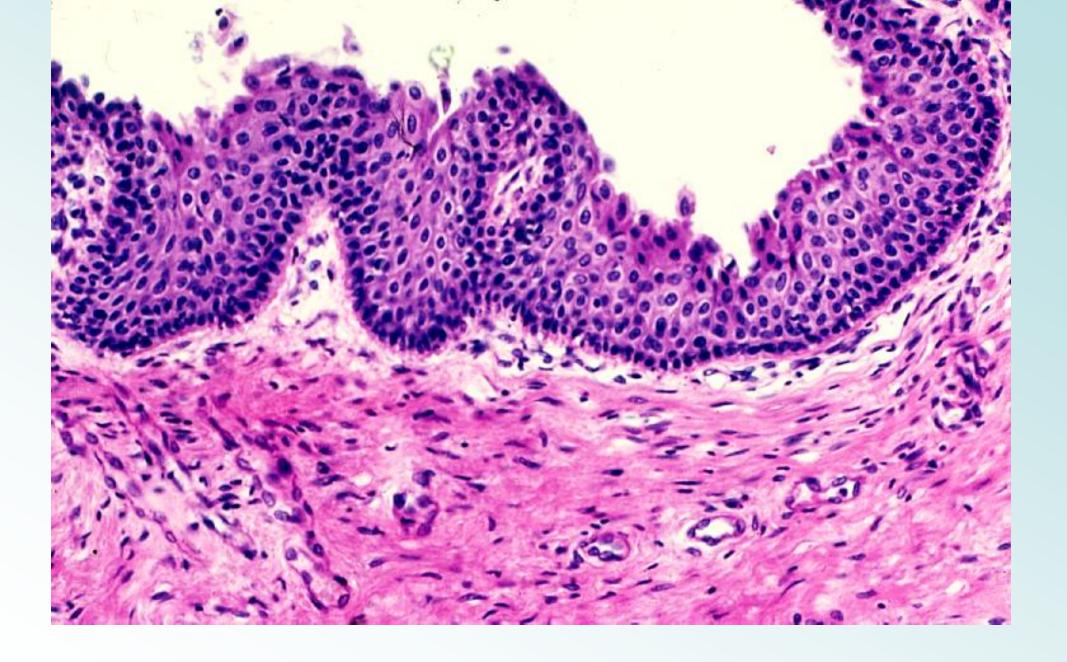
17-004 Vagina and Genitalia

Menu



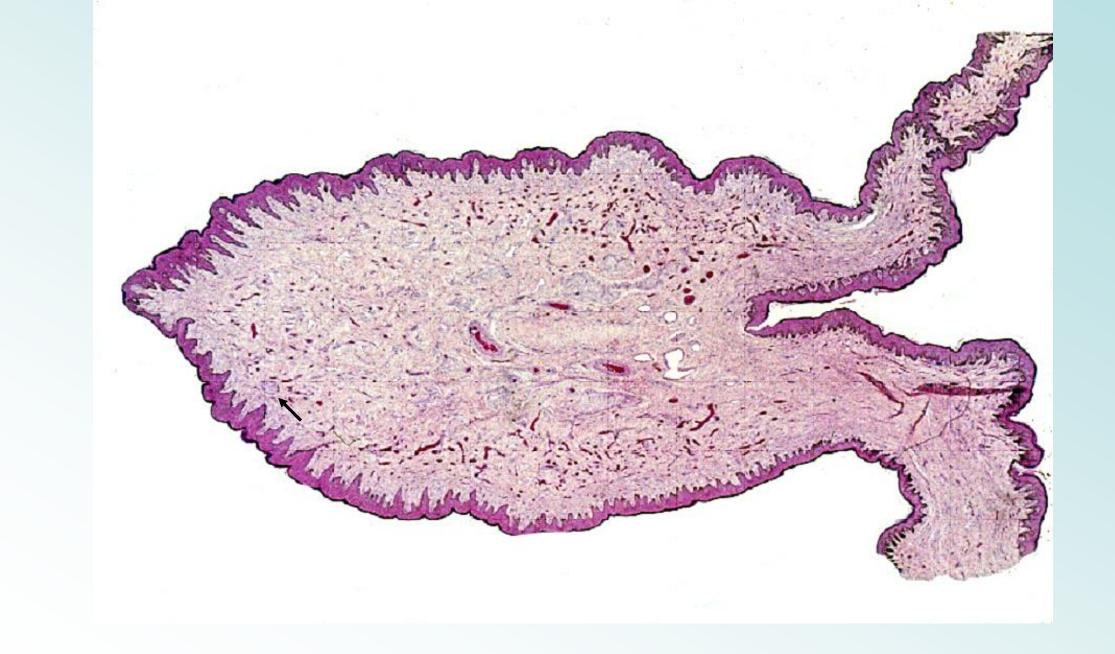


17-53 Anterior wall of vagina and urethra. Transverse section. Human, H-E stain, x 1.7. 📁 Meru Explanation 🦨 Back 📫 Next



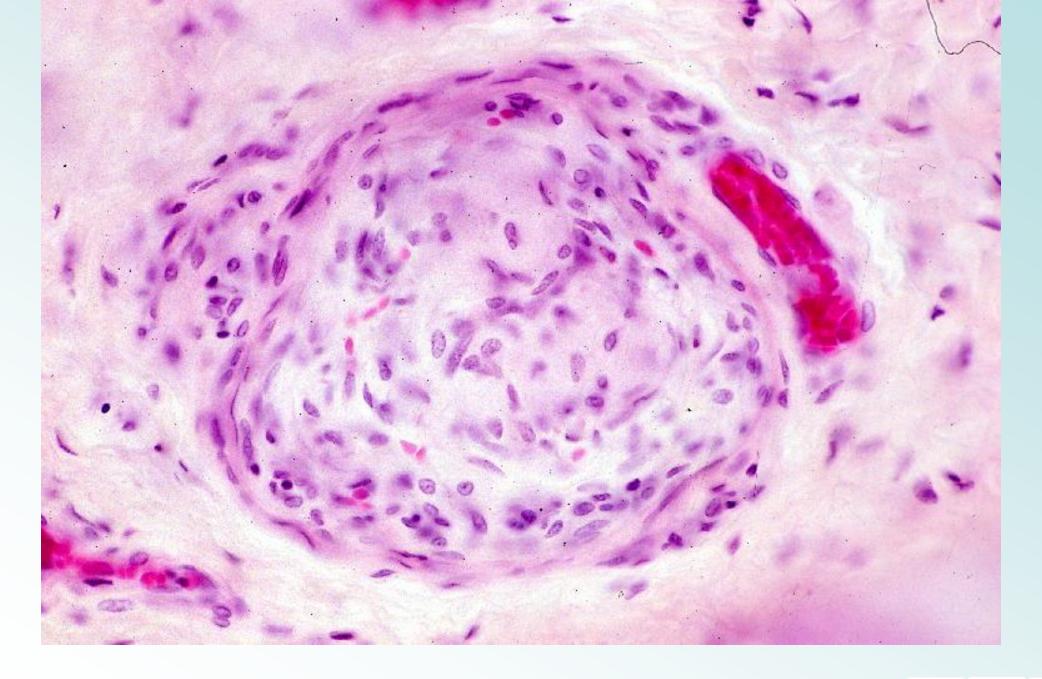
17-54 Epithelium of vagina. Human. H-E stain, x 64.





17-55 Clitoris, longitudinal section. Human, H-E stain, x 3.0.





17-56 Genital corpuscle. Human, H-E stain, x 100.





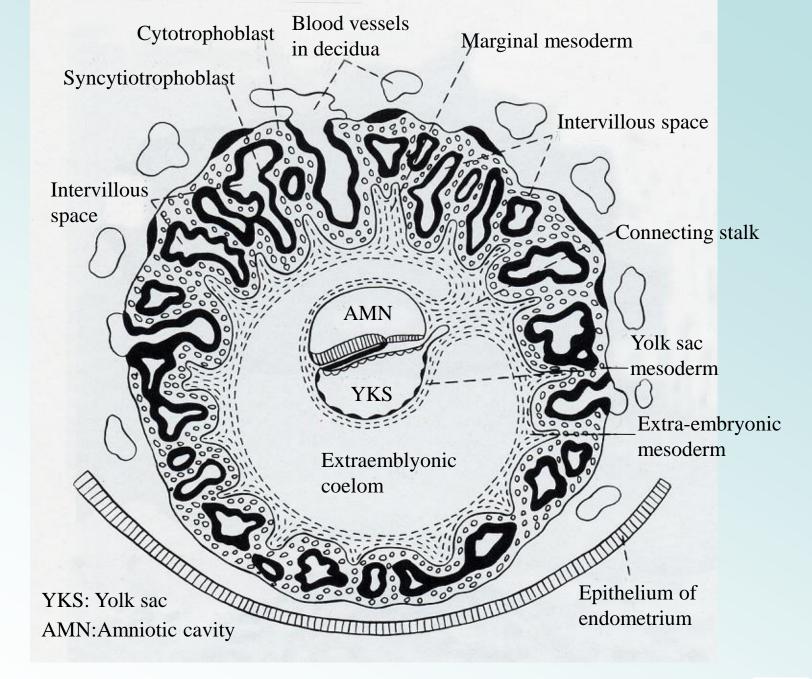
17-57 Labium minus pudendi. Transverse section. H-E stain, x 4.0.



17-005 Placenta

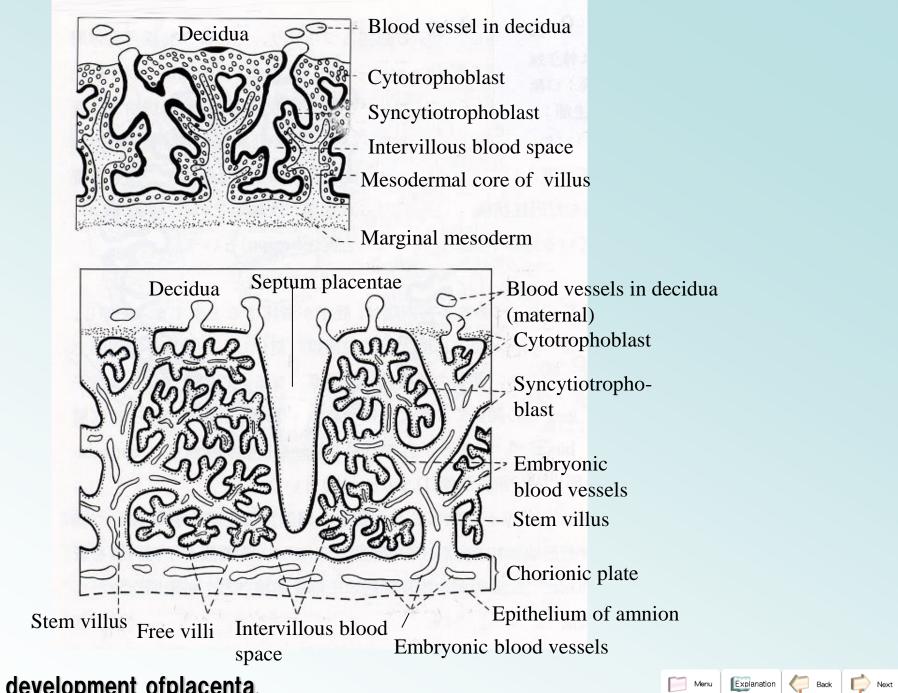
17-005 Placenta



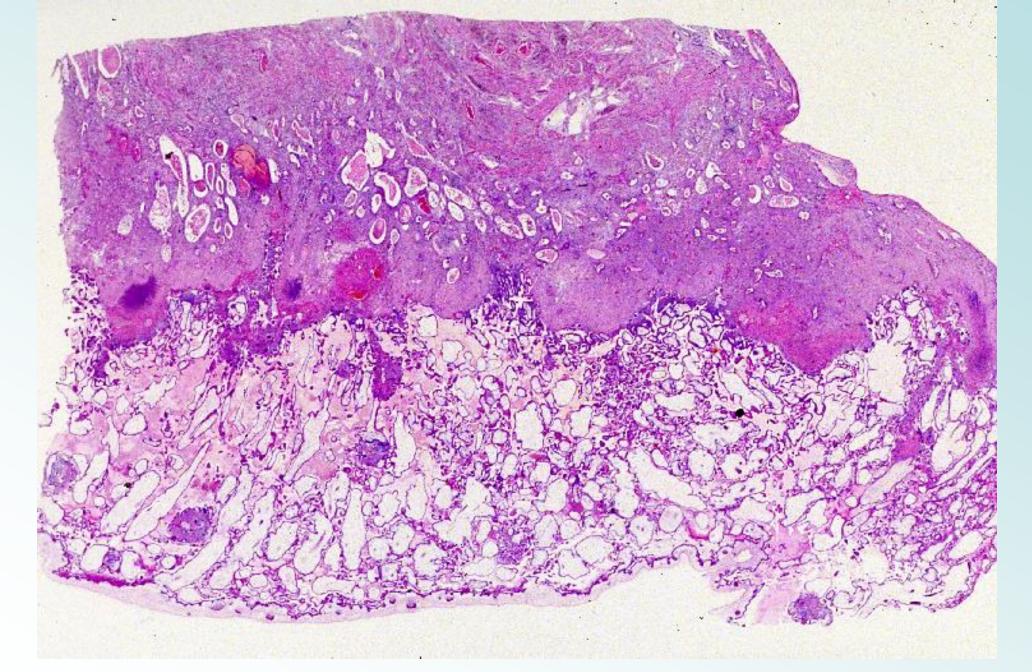


17-58 Scheme showing the development of placenta 1.





17-59 Scheme showing the development ofplacenta.



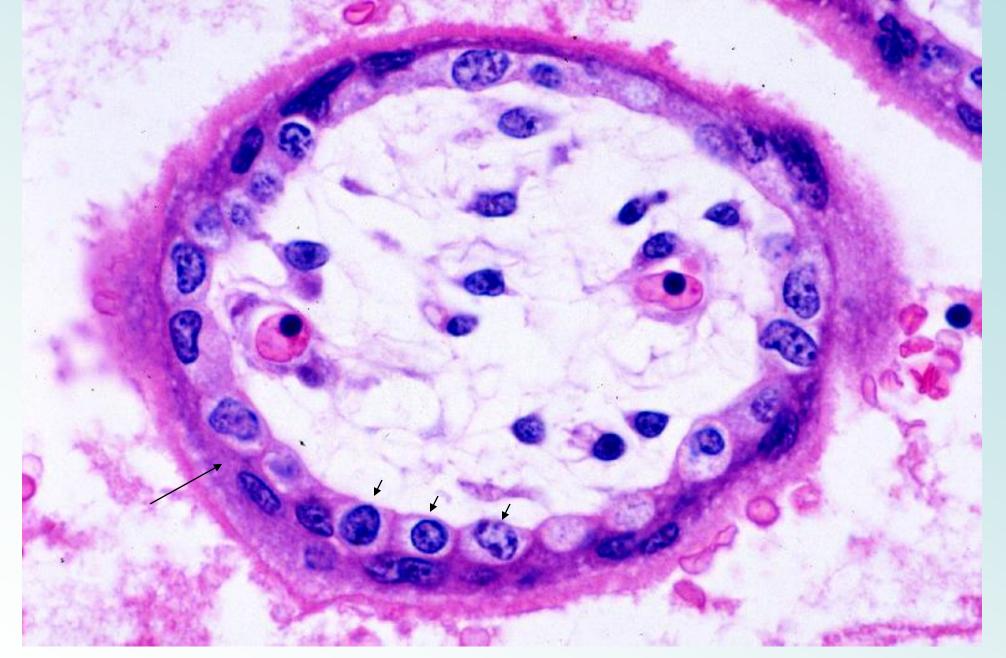
17-60 Placenta on day 51 of gestation 1. Human, H-E stain, x 1.5.





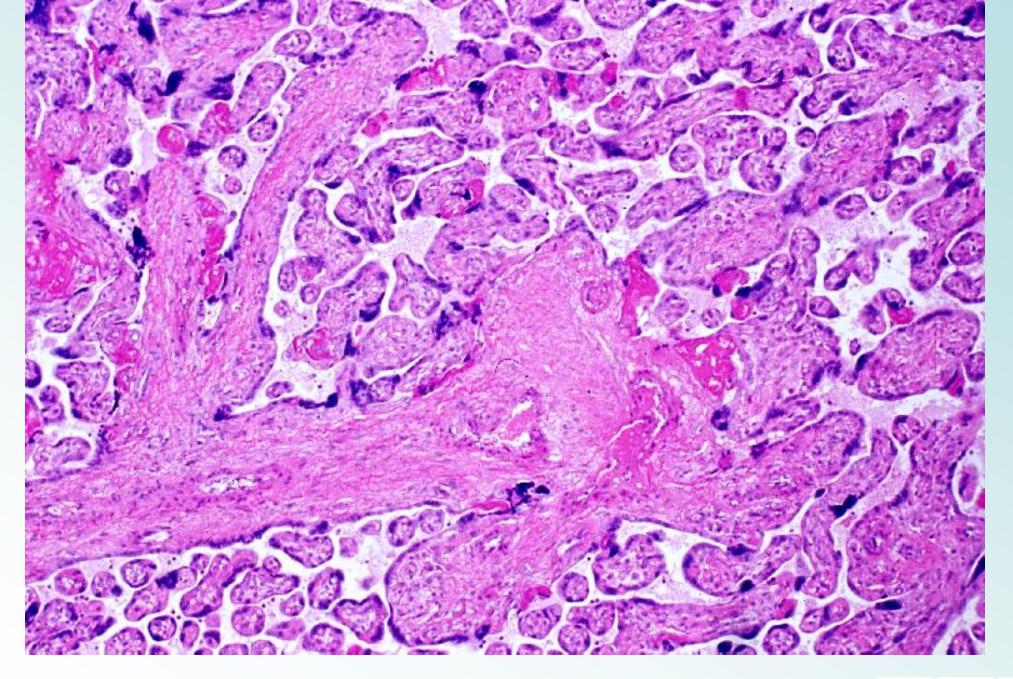
17-61 Placenta on day 51 of gestation 2. Human, H-E stain, x 13.





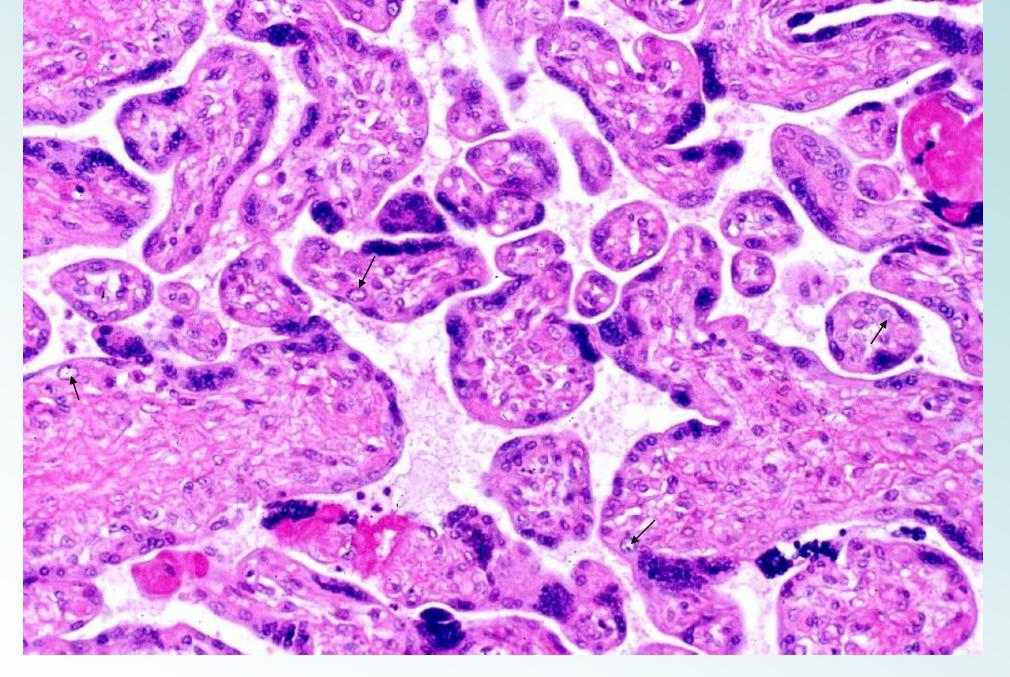
17-62 Placenta on day 51 of gestation 3. Transverse section of a villus. Human, H-E stain, x 200.





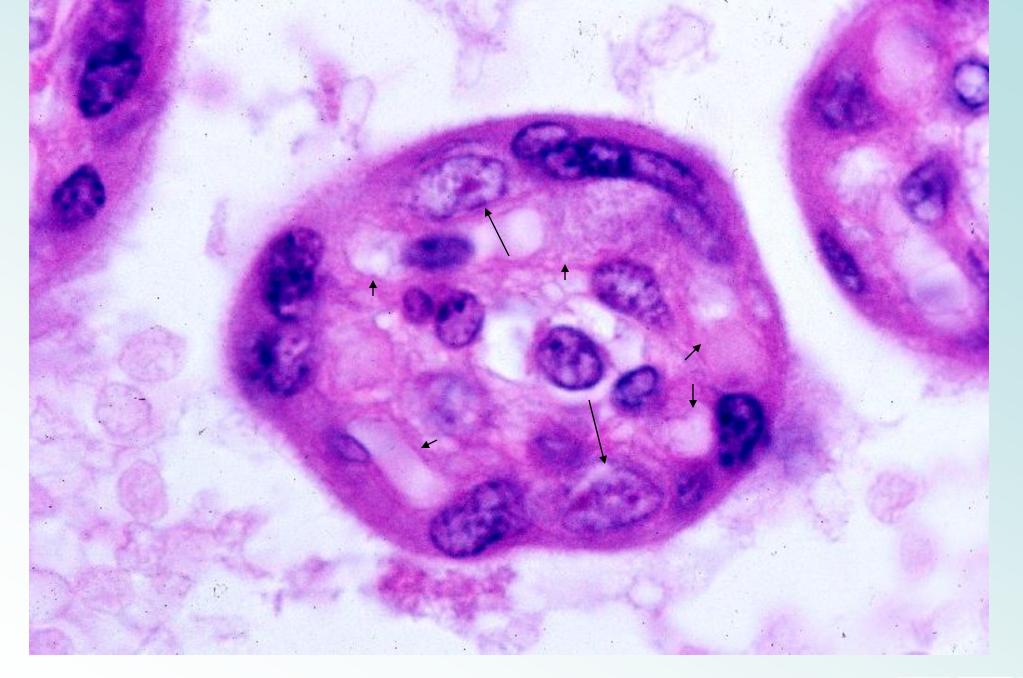
17-63 Placenta after delivery 1. Human, H-E stain, x 25.





17-64 Placenta after delivery 2. Human, H-E stain, x 64.





17-65 Placenta after delivery 3. Human, H-E stain, x 400.



17-006 Mammary Gland

17-006 Mammary Gland





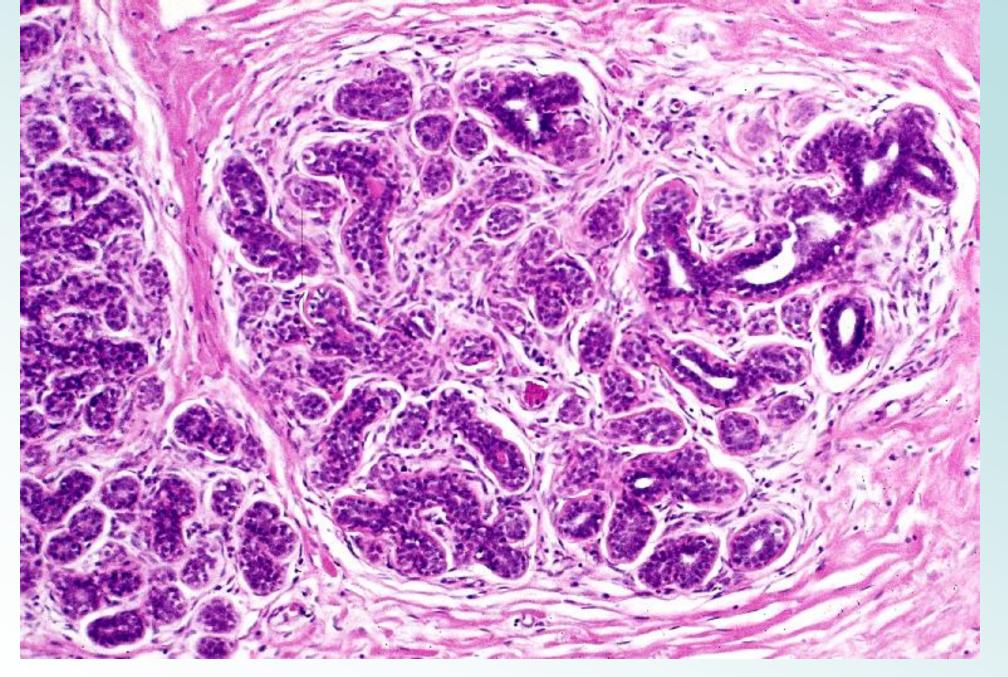
17-66 Nipple and mammary glands, longitudinal section. Human, H-E stain, x 0.7.





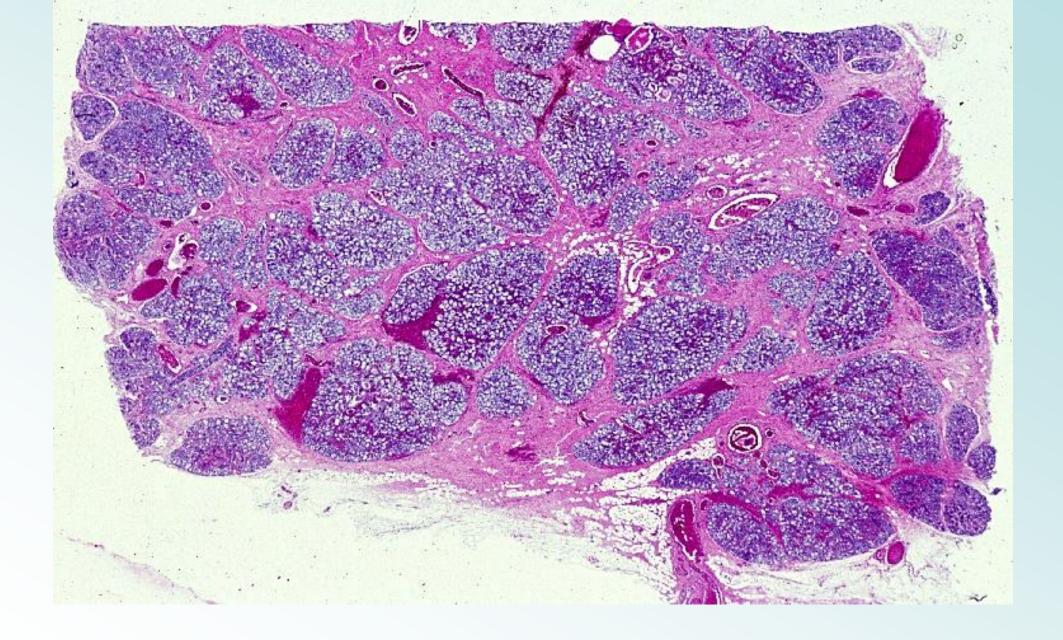
17-67 Nipple, longitudinal section. Human, H-E stain, x 4.0.





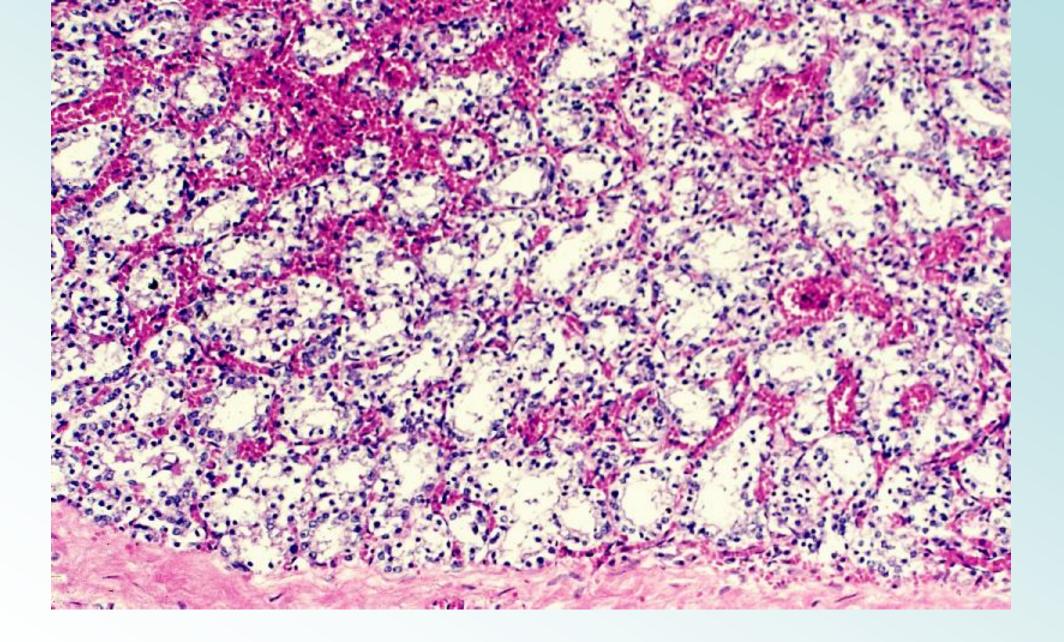
17-68 Mammary gland 1. Resting stage. Human, H-E stain, x 25.





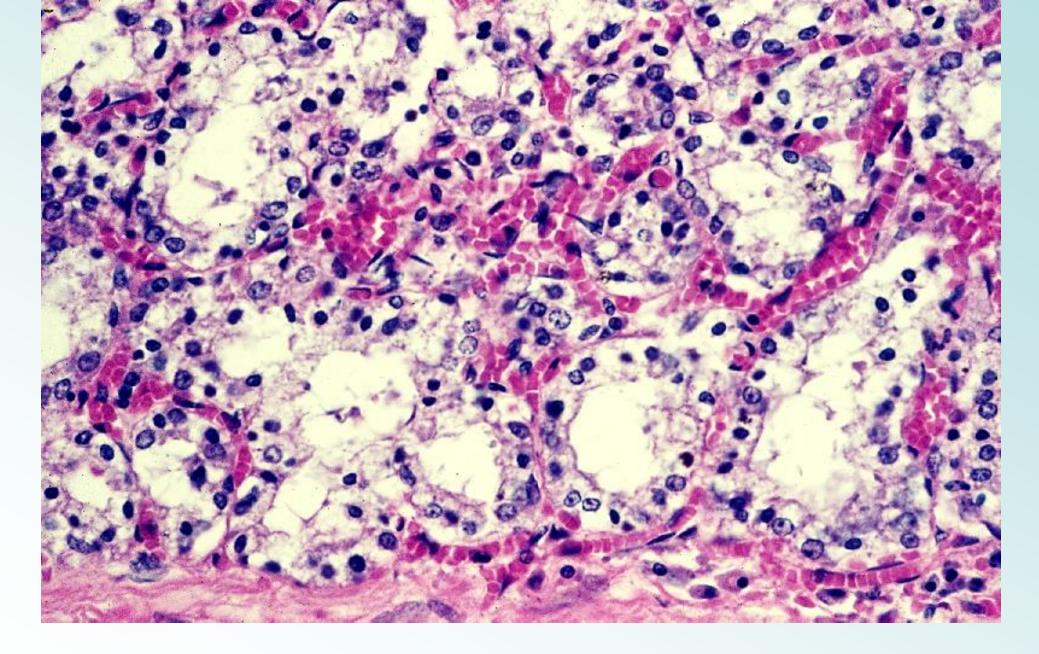
17-69 Mammary gland at term 1. Human, H-E stain, x 2.5.





17-70 Mammary gland at term 2. Human, H-E stain, x 25.





17-71 Mammary gland at term 3. Human, H-E stain, x 100.



17-00 Female Reproductive System

- The female reproductive system consists of ovary, oviduct, uterus, vagina, and genitalia. These are all developmentally incomplete until gonadotrophic hormones of the pituitary gland initiate puberty. The placenta during the pregnancy, and mammary glands are included in the reproductive organs.
- The female reproductive system undergoes the cyclic changes under the control of the gonadotrophic hormones secreted by the anterior lobe of the hypophysis. Cyclic changes of endometrium consists of proliferative phase, secretory phase, premenstrual phase and menstrual phase.
- **Proliferative phase**: endometrium 1~4mm thick; glands straight and narrow; mitosis numerous in all layers; no coiled arteries in upper third.
- Secretory phase: endometrium 4~6 mm thick; glands wide, sinuous, and sacculated; epithelial cells tall with surface blebs: superficial stroma edematous; mitosis confined to coiled arteries which extend to near the surface.
- Premenstrual phase; endometrium 4~5 mm thick; lumen of glands wide and irregular in outline; arteries highly coiled: stroma relatively dense and infiltrated with leuco- cytes.
- Menstrual phase: endometrium 0.5~3 mm thick and denuded of surface epithelium; glands collapsed and short; extravasated blood in a dense superficial stroma; arteries short and relatively straight.
- Neurons in the hypothalamus release gonadotrophin-releasing-hormones (GnRH) that control the release of gonadotrophins (FSH and LH) by the anterior pituitary. Secreting of follicle- stimulating hormone (FSH) stimulates growth of follicles in the ovary. The developing follicles, in turn, secrete estradiol that stimulates endometrial growth and different- iation during the proliferative phase of the menstrual cycle. Estradiol reaching its peak level as midcycle approaches acts back on the hypothalamus, resulting a pulse of GnRH which results in a midcycle surge of lutei- nizing hormone (LH) that triggers ovulation and transformation of the collapsed follicle into a corpus luteum.Secretion of progesteron by the corpus luteum, in the secretory phase of the cycle, induces further change in the endometrium, preparing it for implantation and nutarition of the blastocyst developing from the fertilized ovum during transport through the oviduct. If the cycle is anovulatory, or the ovum is not fertilized, the endometrium breaks down after about two weeks, followed by menstruation



17-01 Scheme showing the female reproductive System.

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This is to show a sagittal section of the female reproductive organs and their relation- ship to the bladder, urethra and rectum.

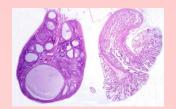


17-001 Ovary

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The ovary is the organ which stores the eggs (ova) and does not produce them. The human ovary is a thumb-top-sized, slightly flattened organ and is suspended from the ligamentum latum uteri by a peritonear fold called mesoovarium.

17-02 Ovary and oviduct. General view. Monkey, H-E stain, x 1.2.



- This figure shows the longitudinal (sagittal) sections of the ovary and the abdominal end of the oviduct, called the infundibulum.
- The ovary is enclosed by the peritoneum and suspended with it from the broad ligament of the uterus. This portion of the
 peritoneum is called mesoovarium. The ovary consists of cortex, thick superficial dense layer, and medulla, axially locating
 loose connective tissue. In the cortex there are numerous egg follicles of various sizes, whereas in the medulla many blood
 vessels, entering and leaving the organ.
- The oviduct expands at abdominal end forming a funnel-shaped opening, called the infundibulum. Its margins turn over ending with fringe-like processes, the fimbriae.



17-03 Overy Sagitall section, general view. Monkey, H-E stain, x 2.0.

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This is a longitudinal section of a macaque ovary, showing the medulla occupying its axial portion and the cortex containing numerous follicles of various sizes and a large corpus luteum.



17-04 Ovary containing a large corpus luteum. Human, H-E stain, x 1.15.

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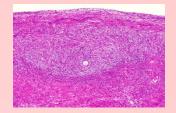
This is a human ovary on day 22 of menstrual cycle, containing a large corpus luteum. Contrary to the macaque ovary, only a few follicles are encountered in the human ovary. Left to the antral follicle there is a corpus albicans.



17-05 Cortex of ovary. Human, H-E attain, x 25.

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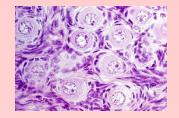


- The surface of the ovary is covered by a simple cuboidal or squamous epithelium, which had been erroneously called germinal epithelium, because it had been believed that the female germinal cells, oocytes, originate from this epithelium. Beneath this is an avascular layer of connective tissue, the tunica albuginea, being much thinner than that of the testis. Further inward is the thick cortex consisting of fibroblast-like cells that arrange very densely in a meshwork of thin collagen fibers. In the middle a primary follicle is evidently seen, higher magnification of which is shown in 17–09.
- Contrary to the macaque ovary, in the human ovary only a few follicles are seen. Com- pare with 17-02, 17-03 and 17-06.



17-06 Primordial egg follicles 1. Monkey, H-E stain, x 160.

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These are the primordial egg follicles observed in the macaque ovary. They consist of large round oocytes, $25 \sim 30 \,\mu$ m in diameter, containing each a spherical nucleus, and surrounded by simple squamous follicular epithelial cells. They are embedded among the stromal cells densely arranging randomly.



17-07 Scheme showing the development of egg follicles and corpus luteum.

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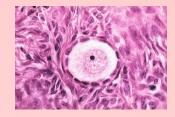
This figure shows the cyclic changes repeating in the adult human ovary, starting from the primordial egg follicle, its maturation, the ovulation, the formation of the corpus luteum and its degeneration (these are depicted clock-wise from the upper left corner to the lower left). This changes are repeating with a cycle of about 28 days.



17-08 Primordial egg follicle 2. Human, H-E stain, x 250.

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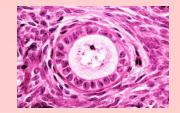
- The primordial germ cells originated from the endoderm of the hindgut migrate to the anlage of the ovary and proliferate there during the embryonic life producing numerous oogonia. At birth the proliferation has ceased and the number of the oogonia are estimated about 2 x 106 in each ovary. These oogonia advance on the prophase of the first meiotic division where they are arrested in the dictyate stage; that means they are already the primary oocytes in early stage. They stay for a long time in this quiescent condition. They are surrounded by a simple squamous epithelium forming the primordial follicles and locate in the superficial layer of the cortex, very densely arranged among the stromal cells.
- This figure shows a human ovum surrounded by a simple squamous epithelium forming the primordial (egg) follicle. This is embedded among the randomly arranged stromal cells.



17-09 Young primary follicle 1. Human H-E stain, x 200.

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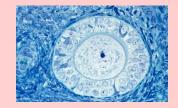
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- The development or maturation of the primordial follicle begins under the control of the gonadotrophic hormones secreted by the pituitary gland. The oocyte grows larger and follicular cells become first cuboidal then proliferate to form two or three layers of cells, that are called the granulosa cells, and the follicle itself is encircled by a distinct basal membrane. These follicles are called the primary follicles.
- This figure shows a young primary follicle consisting of a large round oocyte surrounded by a layer of simple cuboidal cells. Around the follicle encircles a distinct thin basement membrane (arrow), and further outside the stromal cells arrange concentrically to form a theca folliculi.

17-10 Young primary follicle 2. Human, epon section, toluidinblue stain, x 160.

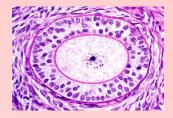
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This is also a young primary follicle; the oocyte is large and contain a large spherical nucleus. The surrounding granulose cells are now arranged in two or three layers. Between the oocyte and granulosa cells there is a distinct limiting membrane, that is the zona pellucida (double arrows) and around the granulosa cells is a thin basement membrane (arrow). Further outside the formation of the theca folliculi is indistinct.



17-11 A little developed secondary follicle. Human, H-E stain, x 160



- Concurrently with the development of the follicle, the stromal cells surrounding the follicle become closely packed around the follicle to form a concentric layers, called the theca folliculi.
- As these changes progress developed follicles dislocate into the deeper layer of the cortex. Numerous primordial follicles follow in turn to develop.
- This figure shows a developed primary follicle consisting of an oocyte about 60 μ m in diameter and granulosa cells of 3~4 layers. The zona pellucida is now thick and stained deep red with eosin. The basement membrane of the granulosa cells is also distinct and surrounded by a theca folliculi consisting of concentrically arranged stromal cells.



17-12 Well developed primary follicle. Human, H-E stain, x 100.

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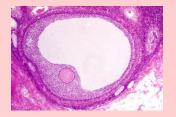
The granulosa cells proliferate rapidly and when the follicles are about 200 μ m in diameter and the granulosa cells surround the oocyte with 6~10 rows, a clear fluid begins to accumulate in inter-cellular spaces among the granulosa cells. As it increases in amount, these spaces become confluent, forming a single crescentic cavity, called antral cavity, and the fluid, liquor folliculi. The oocyte itself is surrounded by several layers of granulosa cells and locates at one side of the follicle. This portion protrudes into the antral cavity and is called the cumulus oophorus. These follicles are called the secondary follicles or antral follicles.

This figure shows a well developed primary follicle. Among the granulosa cells, consisting of 5 to 6 rows, appear the intercellular spaces. The zona pellucida encircling the oocyte is thick and conspicuous and the basement membrane between the granulosea cells and theca folliculi is also evident.



17-13 Graafian follicle 1. Monkey, H-E stain, x 25.

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This is a Graafian follicle found in a macaque ovary. The oocyte is now about 100 μ m in diameter and locates in the cumulus oophorus. The antral cavity is large and lined by a layer consisting of 5~10 rows of granulosa cells, called stratum granulosum.



17-14 Graafian follicle 2. Cumulus oophorus. Monkey, H-E stain, x 64.

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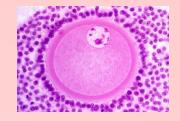


This is higher magnification of the cumulus oophorus in 17–13. The oocyte is circle- round about 100 μ m in diameter and encircled by a thick distinct zona pellucida. The spherical nucleus containing a conspicuous nucleolus is located beneath the cell surface. Granulosa cells directly surrounding the zona pellucida are lined in a regular radiating arrangement, that are called corona radiata



17-15 Oocyte in the cumulus oophorus. Monkey, H-E stain, x 200.

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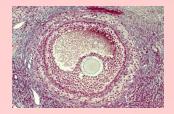


The circle-round oocyte about $100 \,\mu$ m in diameter is encircled by a thick zona pellucida, stained homogeneously deep red, which in turn surrounded by radially arranged granulosa cells, i.e. the corona radiata. The spherical nucleus is located immediatly beneath the oolemma and shows the later stage of the first meiotic prophase.



17-16 Small Graafian follicle 1. Human, M-G stain, x 40.

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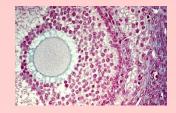


This is a small human Graafian follicle with conspicuous theca folliculi interna. In this specimen collagen fibers in the stroma are evident because they appear blue.



17-17 Small Graafian follicle 2. Human, M-G stain, x 100.

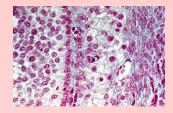
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Higher magnification of 17–16 showing the cumulus oophorus, theca folliculi interna and externa. In the oocyte the nucleus is out of this section. The arrangement of the corona radiate is somewhat disordered. Around the base of the cumulus thin basement membrane is evidently seen. Outside to the basement membrane developed the theca folliculi consisting of two layers i.e. theca folliculi interna and externa.. The theca folliculi interna (A) is composed of stocky fusiform cells with abundant cytoplasm that acquire soon features of steroid-secreting cells and numerous blood capillaries. The theca folliculi externa (B) consists of slender fusiform stromal cells, densely arranged concentrically, and connective tissue fibers. G is the cumulus oophorus consisting of granulosa cells.

17-18 Small Grafian follicle 3. Stratum granulosum, theca folliculi interna et externa. Human, M-G stain, x 160.

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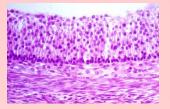


Higher magnification of 17–17. The left one third of this figure is occupied by the stratum granulosum (G), whose basal cells attach to the distinct basement membrane, very alike with the columnar epithelium but another cells above to them are polyhedral or star-shaped and connected together with thin processes. The central one third, right to the basement membrane, is the theca folliculi interna (A), consisting of stocky rounded cells with abundant clear cytoplasm and numerous blood capillaries. The right one third of this figure is occupied by the theca externa (B), consisting of densely arranged spindle-shaped long stromal cells and connective tissue fibers. Boundary between these two layers is not quite clear, because theca externa supplies new cells to the theca interna, that secrete soon the theca-lutein-hormone, estrogen.

17-19 Stratum granulosum, theca folliculi interna and externa. Monkey, H-E stain, x 100.

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This figure shows the stratum granulosum, theca folliculi interna and theca folliculi externa from top to down. The stratum granulosum, surrounding the follicular cavity, stands on the basement membrane and consists of $8 \sim 12$ rows of granulosa cells. It seems to be a pseudostratified columnar epithelium but in fact the cells have not epithelial union to each other. The theca folliculi interna is composed of stocky cells with abundant cytoplasm and a large round nucleus and numerous blood capillaries. The theca folliculi externa consists of densely concentrically arranged spindle-shaped stromal cells. The undermost portion of this figure occupies the stroma ovarii.

In the second half of the follicular phase of the cycle, the majority of the cohort of follicles that have developed to the antral stage begin to undergo atresia, but the domin- ant follicle goes on. There is no further enlargement of its oocyte, which has already reach a diameter of $100 \,\mu$ m, but the follicle as a whole continues to grow over the next 2 weeks with its granulosa cells , increasing enormously. Thus, a follicle that was only 2 mm on day 1 of the cycle comes to measure $15 \sim 20$ mm in diameter at the time of ovulation on day 14.

- The mature follicle is a large vesicle which occupies the full thickness of the cortex and bulges 1 cm or more above the surface of the ovary. The thinning of its wall is due to rearrangements of its cells during the terminal phase of its growth. Accompanying these changes, there is a coalescence of fluid-filled intercellular spaces among the cells at the base of the cumulus oophorus. This results in detachment of the oocyte, its corona radiata and a few adherent granulose cells, which then float free in the liquor folliculi.
- The first indication of impending ovulation is the appearance of a pale oval area on the bulging outer pole of the follicle, called stigma. The change in color is due to local cessation of blood flow in the capillaries of the theca interna. Discontinuities in the germinal epithelium and the connective tissue of the tunica albuginea soon appear, and the thin stigma bulges outward, forming a clear vesicle. Within a minute or two after its formation, the vesicle ruptures and the ovum and its adherent cumulus cells pass through the opening, followed by a small gush of follicular fluid. This is the ovulation.

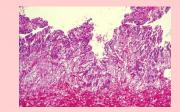


17-20 Corpus rubrum 1. General view. Human, H-E stain, x 1.3.



- This is an ovary on day 16 in menstrual cycle. In its right half a large corpus rubrum is encountered.
- After ovulation and discharge of the liquor folliculi, the wall of the follicle collapses and becomes deeply folded. The basal lamina that formerly separated the granulosa from the theca interna breaks down. At the same time bleeding from the capillaries of the theca interna into the intercellular spaces among the granulosa cells and antral cavity takes place, so that the folded granulosa , as a whole, appears deep red. This is called the corpus rubrum. The cells of the granulosa layer and those of the theca interna undergo striking cytological changes rapidly; they hypertrophy, accumulate lipid droplets, and become plump pale–staining lutein cells.

17-21 Corpus rubrum 2. Luteinization is less progressed. Human, H-E stain, x 25.

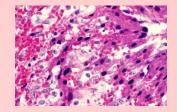


- Higher magnification of a portion of 17–20, where the luteinization is less progressed.
- The undermost zone of this figure, appearing deep red, is filled by the erythrocytes, extravasated from the capillaries. The zone upper to this zone consists of cells of pale-staining plump cells undergoing the changes to the lutein cells. The uppermost zone, surrounding the antral cavity, is composed of cells of deep violet staining cytoplasm; they are in the first step of the luteinization.



17-22 Corpus rubrum 3. Luteinization is not progressed. Human, H-E stain, x 160.

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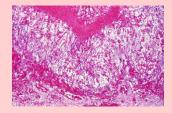


The left one third of this figure is the theca interna, in which cells have undergone the luteinization; their cytoplasm is plump and pale-stained. The right two thirds of the figure is the stratum granulosum, where luteinization is less progressed; in the lower left portion cells are somewhat enlarged and pale-stained but the majority of cells are still slender and their cytoplasm stains deep violet. Their nuclei are elliptic in shape and stain dark violet. They are now beginning to undergo changes into the lutein cells. Among the theca cells as well as gramulosa cells there are a lot of erythrocytes.



17-23 Corpus rubrum 4. Luteinization is progressed. Human, H-E stain, x 25.

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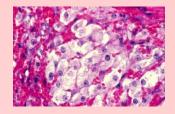


Higher magnification of a portion of 17–20, where the luteinization is progressed. In the middle an undulating thick layer of the granulosa lutein cells traverses. Beneath this layer surrounds a red layer filled by erythrocytes and above, the antral cavity, is also filled by erythrocytes.



17-24 Corpus rubrum 5. Luteinization is progressed. Human, H-E stain, x 160.

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The right three fourths of this figure is occupied by the granulosa lutein cells, that are thick ovoid in shape and of pale-staining cytoplasm. Their nuclei are round and lightly stained. Cells with basophilic cytoplasm are here a few. The left one fourth of the figure is the theca interna; cells are less numerous but they are already luteinized. In this portion, spaces among these cells are also filled by innumerable erythrocytes.



17-25 Corpus luteum graviditatum 1. General view. Human, H-E stain, x 1.3.

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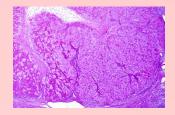


This is a human corpus luteum of the third month of pregnancy, which is fully developed and occupies almost whole interior of the ovary.



17-26 Corpus luteum graviditatum 2. General view. Human, H-E stain, x 10.

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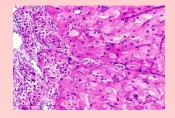


This is the fully developed corpus luteum of pregnancy. The granulosa lutein cells constitute the highly folded thick layer, around (beneath) which surrounds a thin layer of theca lutein cells. At top left is a residue of the antral cavity filled by loose connective tissue.



17-27 Corpus luteum graviditatum 3. Lutein cells. Human, H-E stain, x 64.

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The right three fourths of this figure is occupied by the granulosa lutein cells, plump ovoid in shape, up to 50 μ m in diameter, and containing a round nucleus. Contrary to them, cells occupying the left one fourth of the figure, theca lutein cells, are much smaller, only 15 ~ 20 μ m in diameter, round and somewhat loosely arranged. Among these cells capillaries and small veins are numerously observed.



17-28 Corpus luteum menstruationis 1. General view. Human, H-E stain, x 1.15.

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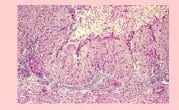


This is a human ovary on day 22 of the menstrual cycle. The corpus luteum is very large, occupying about the half of the whole ovary and consists of highly folded thick layer of the granulosa lutein cells which encloses the residue of the antral cavity.



17-29 Corpus luteum menstruationis 2. Lutein cells 1. Human, H-E stain, x 25.

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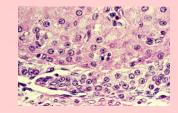


This is a low power view of layers of the granulosa lutein cells (A) and theca lutein cells (B). The residue of the antral cavity is now filled by very loose connective tissue.



17-30 Corpus luteum menstruationis 3. Lutein cells 2. Human, H-E stain, x 160.

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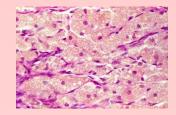


This is a high power view of the granulosa lutein cells (A) and theca lutein cells (B). Among the theca lutein cells a capillary or small vein is conspicuous (arrow).



17-31 Granulosa lutein cells. Monkey, H-E stain, x 160.

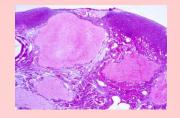
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The granulosa lutein cells contain a lot of lipid droplets but they are all dissolved during the preparatory procedures using alcohol and xylene. Therefore in the usual histological specimens the lipid droplets in the lutein cell are not perceived. This specimen was made by frozen section method so that the lipid droplets are well preserved and their yellowish hue is evident.



17-32 Corpus albicans 1. Human, H-E stain, x 4.0.



- If the ovulated ovum is not fertilized, the corpus luteum begins to regress after 9 or 10 days. The lutein cells undergo autolysis and the region is invaded by macrophages that phagocytize the cellular debris. A pale-staining hyaline scar, called corpus albicans, is left at the site, and this may persists in the ovary for many months.
- In this figure several corpora alvicanta (C) are seen.

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17-33 Corpus albicans 2. Human, Azan stain, x 25.

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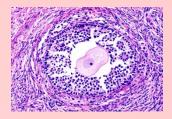


This is a portion of a corpus albicans. The hyaline substance of the corpus albicans stains light blue with aniline blue whereas the collagen fibers in the stroma ovary, the left one fifth of the figure, stains deep blue.



17-34 Atretic follicle. Human, H-E stain, x 80.

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In the normal ovary there are numerous degenerating follicles. Atresia of follicles may begin at any stage of their development. This is an atretic follicle found in a human ovary. The ovum is shrunk and deformed; arrangement of follicular cells is loosen and dispersed, among that two Call-Exner bodies are seen (arrows). The theca folliculi surrounding the follicle is also degenerated.



17-35 Ovary of a human embryo 1. General view. H-E stain, x 4.0.

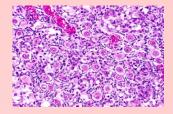
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This is a general view of a human embryonic ovary, which consists of thick cortex containing numerous primordial follicles.

17-36 Ovary of a human embryo 2. H-E stain, x 64.

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The primordial follicles fill the cortex of ovary. Each follicle consists of an oogonium, a large round cell, and surrounding simple squamous follicular cells. The spaces among them are loosely filled by stroma cells.



17-002 Oviduct

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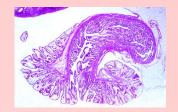
The oviduct is a long tubular organ, $10 \sim 15$ cm in length, which accepts the ovum ovulated from the ovary and transport it until the uterine cavity. It starts at the lateral corner of the fundus uteri, runs laterally in the upper free border of the broad ligament of the uterus, and opens at the distal end into the peritoneal cavity, with a funnel-shaped expand, called infundibulum. Its abdominal margins are drawn out into numerous fringe-like processes, the fimbriae. The expanded intermediate portion proximal to the infundibulum is called the ampulla and the thin tubular portion near the uterus is the isthmus.

The wall of the oviduct consists of mucous membrane, muscle layer, and serosa. The mucous membrane projects numerous folds into the lumen; they are in the infundibulum especially tall and repeatedly branch and anastomose so that the lumen becomes labyrinthine. The muscle layer consists of roughly inner longitudinal, intermediate circular, and outer longitudinal smooth muscle fibers. These muscle fibers contract rhythmically and cause peristaltic movements of the oviduct, by which the ovum is transported into the uterine cavity. The serosa is the peritoneum itself.



17-37 Ostium abdominale tubae 1. General view. Monkey, H-E stain, x 2.0.

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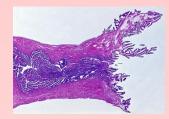


This is the longitudinal section of the infundibulum and fimbriae of a macaque oviduct. The abdominal margins of the infundibulum turn over and its mucous membrane makes numerous fringe-like processes, fimbriae, that flatter in the peritoneal cavity.



17-38 Ostium abdominale tubae 2. General view. Human, H-E stain, x 2.4.

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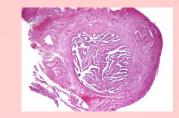


This is the longitudinal section of the infundibulum and fimbriae of a human oviduct. The fimbriae are here less numerous and much thinner than those of 17-37.



17-39 Oviduct, transverse section. Human, H-E stain, x 5.0.

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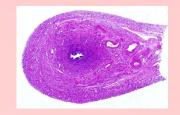


This is the transverse section of the ampulla of a human oviduct. The mucous membrane protrudes into the lumen forming numerous folds, short and long, that branch repeatedly, so that the lumen appears as labyrinth.



17-40 Isthmus tubae, transverse section. Human, H-E stain, x 6.5.

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This is the transverse section of the isthmus of a human oviduct. The lumen is here narrow and folds of mucosa are low and less numerous; the muscle layer is relatively thick.



17-41 Epithelium of oviduct. Human, H-E stain, x 250.

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- The epithelium of the oviduct consists of simple columnar cells of two kinds. The one are tall columnar cells with prominent cilia, that flutter actively and cause a flow toward the uterus, by which the ovulated ovum is swallowed into the oviduct and conveyed through it toward the uterus. The others are tall secretory cells without cilia, intermingled among the former. The mucous membrane of the oviduct is under the influence of the hormones secreted from ovary and undergoes the cyclic changes.
- This figure shows the epithelium of a human oviduct on day 22 in the menstrual cycle. The differences between the two kinds of epithelial cells are evident. The terminal bar of the ciliated cells is conspicuous.



17-003 Uterus

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The uterus is a pear-shaped organ with a thick muscular wall, about 7 cm long, 4 cm across at its widest, and 2.5 cm thick. It is slightly flattened and normally tipped forward. The peritoneum covering its dorsal and ventral surfaces continues from the side of the organ to the wall of the pelvis, forming two leaves of the broad ligaments which support the organ. The rounded upper portion is called the fundus and lower to this follow the body, corpus uteri, and further cervix uteri. The axial portion of the organ occupies a flattened cavity, cavum uteri, triangular in outline, which continues with its two upper corners with the lumina of the oviducts and with its lower corner with the cervical canal opening into the vagina.

17-42 Uterus, transverse section. General view. Monkey, H-E stain, x 1.7.

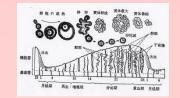
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- This is a transverse section of the body of a macaque uterus. In the middle is the uterine cavity, cavum uteri, which is surrounded concentrically by the mucous membrane, endometrium, thick muscle layer, myometrium, and thin peritoneum, peri- metrium, which is very thin and not perceivable at this magnification. The peritoneum, covering the dorsal and ventral surfaces of the organ becomes at the sides two leaves of the broad ligament, ligamentum latum uteri, which continues to the wall of the pelvis and acts as a support of the organ. Through the broad ligament blood vessels, lymphatics and nerves enter and leave the organ.
- The endometrium undergoes cyclic changes under the control of hormones secreted by ovary, that will be discussed later.
- The myometrium is the thick layers of smooth muscle fibers that interlace in all directions and as a whole, acts to drive out the fetus at delivery.



17-43 Scheme showing the interrelationship between ovary and endometrium.



- The mucous membrane of the uterus, endometrium, undergoes the cyclic changes under the control of the hormones secreted by the ovarium. This scheme shows the interrelationship between the ovary and endometrium.
- In a normal menstrual cycle, the endometrium goes through a cobtinuous sequence of histological changes, which are divided into three stages: the proliferative, the secretory and the menstrual phages. The proliferative phase coincides with the secretion of the estrogen by the growing follicles. The secretory phase is the period during which a functional corpus luteum is secreting progesteron. The menstrual phase is a period of degeneration associated with a rapid decline in stimulation of the endometrium by ovarian hormones.



17-44 Endometrium on day 3 of menstrual cycle. Human, H-E stain, x 10.

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- This is the endometrium on day 3 of the menstrual cycle. Except for the basalmost thin layer, the stratum basale, all the superficial layers of the endometrium, the stratum functionale, were lost and now the surface of it is the wound. In the remaining basal layer only a few sections of the uterine glands are seen.
- Compare the figures $17-44 \sim 17-48$ to understand the menstrual changes of the human endometrium, at the same magnification; all of them are operation materials.



17-45 Endometrium on day 7 of menstrual cycle. Human, H-E stain, x 10.

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This is the endometrium on day 7 of the menstrual cycle. The superficial wound is restored and the epithelium covers the surface, and above the basal layer the func- tional layer is newly formed, in which longitudinal sections of the uterine glands with spiral course are seen. The stroma cells among the uterine glands are arranged loose. In the basal layer the stroma is densely invaded by the leucocytes.



17-46 Endometrium on day 14 of menstrual cycle. Human, H-E stain, x 10.

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This is the endometrium on day 14 of the menstrual cycle. The functional layer is quite thick but its structure is relatively loose. The lumina of the uterine glands, moderately coiled, widen and begin to secretion. The stroma among the uterine glands is not so rich in blood vessels. The ovulation may occur on this day.



17-47 Endometrium on day 22 of menstrual cycle. Human, H-E stain, x 10.

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- This is the endometriim on day 22 of the menstrual cycle. The thickness of it reaches at maximum, about 5 mm. The uterine glands are lengthened, becoming tortuous and showing lateral sacculations that give them a relatively large lumen of irregular outline. In the basal zone the glands remain slender and their lumina show smoose contour. Among the widened stroma there are numerous blood and lymph vessels. The spiral arteries extend into the stroma near the surface. Numerous veins of straight course toward the basal layer are seen in the stroma between the glands. Lymphatics of large caliber are also numerously seen.
- In the superficial portion the stroma cells proliferate and take on an epithelioid appearance and become concentrated to form the stratum compactum, distinct from a stratum spongiosum in the lower portion where the stroma cells do not undergo this cytological change and interspaces among them are widened and filled by fluid exuded from the blood vessels resulting in the edematous appearance. In the most basal portion the stroma is invaded by a lot of leucocytes densely.



17-48 Endometrium on day 28 of menstrual cycle. Human, H-E stain, x 10.

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This is the human endometrium on day 28 of the menstrual cycle, showing the condition directly before the onset of menstruation. In the superficial portion, stroma cells become plump and densely packed without the intercellular spaces, showing the condition of decidualization. Lower to this zone, in the stratum spongiosum the intercellular spaces of stroma cells open but edematous condition is not distinct and glands collapsed. At the lowermost zone, indicated with an arrow, the stroma is loosen and ischemic and here breaking off of the zona functionalis will occurs. In the stratum basale the gland are short and slender and the stroma is invaded by innumerable leucocytes.

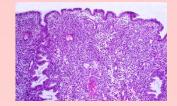
If the ovulated ovum is not fertilized, marked vascular changes occur in the endometrium about two weeks after ovulation. The endometrium is blanched for hours at a time, owing to constriction of the spiral arteries that deprives the zona functionalis of oxygenated blood. The endometrium stains more deeply and appears more cellular because it has lost much of its interstitial fluid. The glands cease to secrete and the stroma is invaded by large numbers of leucocytes. After about 2 days of intermittent interruption of blood flow to the upper two-thirds of the endometrium, constriction of the spiral arteries becomes continuous, resulting in ischemia of the zona functionalis, while blood continues to flow in the zona basalis. Necrotic changes in the zona func- tionalis progress. Hours later, the constricted arteries reopen, permitting blood to flow through vessels that have been damaged by ischemia. Vessel walls rupture and blood escapes into the stroma and soon breaks out into the uterine lumen. Clumps of blood-soaked necrotic endometrium break away leaving the torn ends of glands and open ends of blood vessels exposed at a new surface. Blood continues to ooze from the open ends of veins, contributing to the menstrual flow. Normally this blood does not clot. By the third or fourth day of menstruation, the entire functionalis has sloughed off.

 The zona basalis of the endometrium remains intact and viable, and before menstrual flow has entirely ceased, epithelial cells begin to proliferate and migrate from the open ends of the glands to restore a surface epithelium. New blood vessels sprout from those at the base and the stroma cells proliferate and secrete the fibrous and amorphous com- ponents of an abundant extracellular matrix. With the onset of these regenerative activities, the proliferative phase of new cycle begins.



17-49 Superficial portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 25.

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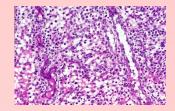


In the superficial portion the stroma cells proliferate and take on an epithelioid appearance and become concentrated to form the stratum compactum. This change is called the decidualization. This figure shows its beginning condition. In the lower half of this figure shows the stroma edematous appearance. The glands are highly tortuous and their lumina show lateral sacculation with irregular outline.



17-50 Deeper portion of endometriom on day 22 of menstrual cycle. Human, H-E stain, x 64.

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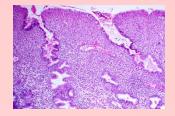


This figure shows the edematous stroma containing a spiral artery and a straight vein. The stromal cells are here stellate in form and unite each other with long processes. Intercellular spaces are wide and filled by fluid exuded from the bluud vessels, that is edema. In the left there is a spiral artery goes upward through the edematous stroma, in the right is a vein, which runs straight from top downward.



17-51 Superficial portion of endometrium on day 28 of menstrual cycle. Human, H-E stain, x 25.

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This is the superficial portion of human endometrium on day 28 of the menstrual cycle in which the stroma cells are enlarged and densely packed without intercellular spaces and the decidualization of the endometrium is accomplished. In the lower half of this figure intercellular spaces are narrow and ischemic.



17-52 Cervical canal, longitudinal section. Human, H-E stain, x 1.2.

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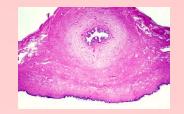
The cervix uteri is a cylindrical portion which is continuous with the uterine body, above, and protrudes into the vagina as portio vaginalis, below. The axial portion of it penetrates the cervical canal, which opens above into the uterine cavity and below into the vagina through the external os. The canal is lined by a mucosa with a highly irregular surface with numerous ridges or folds called the plicae palmatae. The mucosa of the cervix does not undergo cyclic changes. The wall of the cervix is composed mainly of dense connective tissue containing a small numbers of smooth muscle fibers.

17-004 Vagina and Genitalia



17-53 Anterior wall of vagina and urethra. Transverse section. Human, H-E stain, x 1.7.

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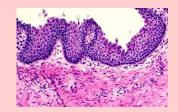
The vagina is a flattened tube, $8 \sim 9$ cm in length, $2 \sim 3$ cm in width, extending from the uterine cervix to the vestibulum of the female external genitaria, and has the anterior and posterior walls. Anterior to the vigina runs the female urethra from the urinary bladder to the vestibulum along the midline, causing a slight rise of the anterior wall of the vagina into the lumen, called urethral carina.



17-54 Epithelium of vagina. Human. H-E stain, x 64.

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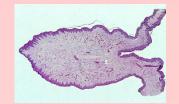
The wall of vagina consists of the mucosa, the muscular coat, and adventitial connective tissue. The mucosa consists of a stratified squamous epithelium and underlying lamina propria. The epithelium is $150 \sim 200 \,\mu$ m in thickness and composed of several to ten rows of cells, whose cytoplasm is filled with glycogen and stains deep violet. The superficial cells are continuously shed into the lumen and glycogen from the desquamated cells is rich substrate for certain members of the bacterial flora, which break it down to lactic acid, lowering the pH of the vagina.

This figure shows the vaginal epithelium attaching to a distinct basement membrane. The epithelial cells are polyhedral in shape and their cytoplasm stains deep violet. The superficial cells containing the nucleus are desquamated successively.



17-55 Clitoris, longitudinal section. Human, H-E stain, x 3.0.

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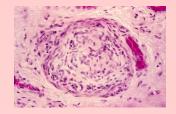


This is a horizontal longitudinal section of a human clitoris, which corresponds to the dorsal portion of the penis in the male. It consists of connective tissue core and covering thin skin. In the core there are paired rudimentary corpora cavernosa. The skin is thin but numerous papillae are encountered. Beneath the skin a genital corpuscleis seen.



17-56 Genital corpuscle. Human, H-E stain, x 100.

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This is a genital corpuscle found in the clitoris (17–55). In the subcutaneous connec- tive tissue of the clitoris is rich in nerve endings. One of them is the genital corpuscle, which is a round corpuscle consisting of nerve endings and Schwann cells and encircled by connective tissue capsule.

17-57 Labium minus pudendi. Transverse section. H-E stain, x 4.0.

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The labia minora pudenda are thin folds of skin flanking the vestibulum vaginae. This figure shows a labium minus pudenda transversely sectioned. The epidermis is relative- ly thick and cells of its germinal layer contain much melanin granules. The connective tissue core contains numerous blood vessels and nerves. The labia minora have no hairs but there are numerous small sebaceous glands



17-005 Placenta (1/2)

- Directly after the ovulation fertilization takes place in the infundibulum of the oviduct. The fertilized ovum, zygote, is conveyed toward the uterus through the oviduct by the flow caused by fluttering of the epithelial cilia and also by peristaltic movement of the musculature of the oviduct. During the conveyance zygote divides once about a day repeatedly, forming a small spherical mass of cells called the morula. It arrives at the uterine lumen on about the fourth or fifth day as the blastcyst, consisting of numerous cells with a central cavity in its interior. On about the sixth day after fertilization the zona pellucida is loosen and disappears, and the blastcyste attaches to the surface of the secretory endometrium. The endometrium responds by transformation of its fusiform or stellate stromal cells into large, polyhedral, pale-staining decidual cells. They contain large stores of glycogen and lipid in their cytoplasm, with that they prepare a favorable milieu for nutrition of the early embryo.
 - At this time there is a cluster of cells at one pole of the blastcyst, called the inner cell mass, which is destined to form the embryo proper, whereas the remainder of the hollow sphere consists of trophoblast cells, that will form the placenta. The blastcyst attaches to the endometrium at the pole of the inner cell mass and begins to invade into the endo- metrium. The trophoblast cells proliferate rapidly and give rise to an inner layer of cytotrophoblast, composed of separate cells, and a thick outer layer, the syncytiotro- phoblast, which is a continuous multinucleate layer of cytoplasm, in which no cell boundaries are discernible. The cytotrophoblast proliferates actively and continuously forms new cells that fuse with, and are incorporated into, the growing syncytio- trophoblast.

17-005 Placenta (2/2)

- The syncytiotrophoblast actively erodes the endometrium, enabling the blastocyst, as a whole, to sink deeper into it. By the 11th day, the blastocyst is entirely within the endometrium, and surrounded by thick syncytiotrophoblast. This course is called the implantation. The discontinuity created in the surface of the endometrium is covered by cellular debris in a fibrin clot until the epithelium regenerates over the implantation site.
- As the expanding layer of syncytiotrophoblast around the blastocyst continues to invade the surrounding endometrium, appears in it a labyrinthine system of intercom- municating lacunae filled with blood liberated from blood vessels in the endometrium eroded. This blood is the initial source of nourishment for the embryo, and its liberation from endometrial vessels is the first step toward establishment the utero-placental circulation on which the growth of the fetus will later depend.
- At 11 days postovulation, the embryo proper is a bilaminar disc consisting of a thick plate of columnar epitheliar cells, the ectoderm, and a thinner layer of squamous or cuboidal cells, endoderm. The ectodermal plate is continuous at its margins with a layer of squamous cells that enclose a small amniotic cavity. The endoderm is continuous at its margins with a sheet of cells that encloses the yolk sac. A wide space, exocoelom, between these derivatives of the inner-cell mass and the trophoblastic sell is traversed by thin strands of extraembryonic mesenchyme. The broad peripheral zone of the trophoblast is henceforth called the chorion.

17-58 Scheme showing the development of placenta 1.

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- From the 11th to the 16th day, the products of conception, embryo, continue to enlarge at the expense of the surrounding endometrium. Erosion of endometrial blood vessels becomes more extensive with many communications forming between the endometrial venous sinuses and the lacunae within the syncytiotrophoblast. From the 15th day onward, cords of trophoblast grow outward from the trophoblastic shell to the opposite wall forming the **primary chorionic villi**. These are soon invaded at their base by mesenchyme that advances to their tips, converting the primary villi into **secondary chorionic villi**, consisting of an outer layer of syncytiotrophoblast and an inner layer of cytotrophoblast around a core of mesenchyme. They are bathed in maternal blood that flows sluggishly through a system of intercommunicating vascular channels that collectivrly form the **intervillous space**. The cytotrophoblast beneath the syncytio- trophoblast of each secondary villus advances and reaches the opposite wall and pentrates the syncytiotrophoblast, and spreads laterally over the syncytiotrophoblast, coalescing with similar outgrowth from neighbaring villi to form a continuous tropho- blastic shell, which is interrupted only at site of communication of maternal blood vessels with the intervillous space.
 - This scheme shows the conditions of products of conception at this stage. The secondary chorionic villi consist of mesenchymal core, surrounding cytotrophoblast, and superficial syncytiotrophoblast being bathed in the maternal blood. They are called stem villi, later. They stand on the basal surface of the intervillous blood spsce and continuous with the trophoblast of another side, i.e. decidual surface of the intervillous blood spaces.

17-59 Scheme showing the development ofplacenta. (1/2)



- ①:End of the 4th week.
- 2: end of the 4th month.

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- Figure ① shows a portion of the stem villi and inetervillous blood spaces. The base of each stem villus stands on the marginal mesoderm (mesenchyme), from which the mesenchymal core enters into the villus. This core is enveloped by the cytotrophoblast and syncytiotrophoblast. From the surface of the villus numerous side branches pro- trude into the intervillous blood spaces. In the mesenchyme of marginal mesoderm and core of each villus appear capillary vessels which are continuous with blood vessels of the fetus.
 - Figure ② shows a more developed condition of the placenta. The stem villi grow longer, widening the distance between the chorionic plate and decidua. The branches of the stem villi branch repeatedly resulting in innumerable free ending small branches that fill the enlarged intervillous blood spaces. Capillaries in the mesenchymal core progress distalward and reach the tip of each branch, directly beneath the syncytio- trophoblast. Thus the exchange of nutrient substances in the maternal blood and waste in the embryonic blood takes place efficiently through the enormously wide surface of the chorionic villi.
 - As the stem villi grow higher, the decidual tissue between two stem villi is left behind and protrudes into the intervillous space as a septar plate covered by the syncytio- trophoblst and cytotrophoblast. This is called the **septum placentae**.

17-59 Scheme showing the development ofplacenta. (2/2)

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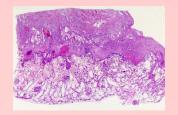


- During the development of embryo, the decidua differentiates into three portions: (1) decidua between the embryo and myometrium, **decidua basalis**, which elaborates later the maternal portion of the definitive placenta. (2) decidua between the embryo and uterine cavity, **decidua capsularis**, which covers the embryo. (3) decidua lining the remainder of the uterus, **decidua vera**.
- As the embryo grows larger, decidua capuslalis covering the embryo bulges highly into the uterine lumen making this narrower and finally attachs to the decidua vera of the opposite wall of the uterus resulting in the obliteration of the uterine cavity.
- Up to the end of the eighth week of gestation, the vlli are equally numerous around the entire circumference of the chorion. As
 pregnancy advances, villi associated with the decidua basalis rapidly increase in number and length, whereas those associated
 with the decidua capsularis degenerate, so that by the third month this surface of the chorion is smooth and relatively
 avascular. Henceforth, this region is called the chorion leave, whereas in the portion associated with the decidua basalis villi
 develop highly and this portion is called the chorion frondosum. This discoid basal area of the chorion goes on to form the fetal
 portion of the definitive placenta
 - By four and half months, the uterine lumen is largely obliterated, the decidua capsu- laris is no longer present and the chorion leave has fused with the decidua vera on the opposite side of the uterine lumen. In the subsequent development of the placenta, there is a steady increase in number and length of the villi of the chorion frondosum and an expansion of the intervillous space.



17-60 Placenta on day 51 of gestation 1. Human, H-E stain, x 1.5.

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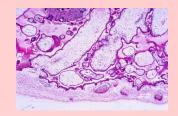


This is a human placenta on day 51 of gestation, from the chorionic plate (lower edge) to the decidua (upper thick violet tissue). From the chorionic plate stand numer- ous stem villi toward the decidua but their branches in the intervillous spsce are still not so many.



17-61 Placenta on day 51 of gestation 2. Human, H-E stain, x 13.

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Higher magnification of the chorionic plate and stem villi of 17–60. In the chorionic plate and stem villi the fetal blood vessels are seen. The stem villi are quite thick but their free branches are not so numerous. The surface of chorionic plate and that of stem villi are throughout covered by the syncytiotrophoblast.



17-62 Placenta on day 51 of gestation 3. Transverse section of a villus. Human, H-E stain, x 200.

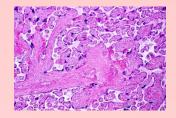
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Higher magnification of 17–60. This is a transverse section of a villus. The surface of the villus is covered by the syncytiotrophoblast, consisting of numerous dark nuclei and deep violet staining cytoplasm, which has conspicuous microvilli but devoids entirely cell boundary. Directly beneath it underlies the cytotrophoblast composed of separate cells. They are round in shape and their cytoplasm is clear (arrows). The core of the villus consists of very loose connective tissue, mesenchym, containing small numbers of stellate cells, among which two fetal capillaries containing each one nucleated primitive erythroblast are seen. Around the villus is the intervillous blood space in which maternal erytrocytes are recognized.

17-63 Placenta after delivery 1. Human, H-E stain, x 25.

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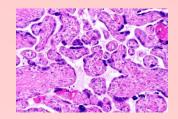


This figure shows a stem villus and innumerable sections of free villi, filling the intervillous blood space. In the stem villus large and small blood vessels of fetus are seen. The surface of the stem villus and of small villi are all covered by a thin layer of syncytiotrophoblast stained deep violet.



17-64 Placenta after delivery 2. Human, H-E stain, x 64.

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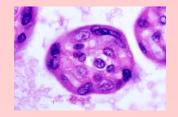


Higher magnification of 17–63. The large and small sections of chorionic villi are shown. They are all enclosed by a thin layer of syncytiotrophblast. As the development of the placenta progresses the cytotrophoblast divides very actively to supply the new cellular components to the syncytiotrophoblast which covers the growing branches, but in the later term of gestation, where growth of the placenta is slowed down, division of cytotrophoblast becomes less active and the cells that performed the final division coalesce into the syncytiotrophoblast and disappear. In the placenta after delivery the cytotrophoblast–cells are seldom encountered beneath the syncytiotrophoblast. Arrows indicate the cytotrophoblast–cell.



17-65 Placenta after delivery 3. Human, H-E stain, x 400.

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This is a higher magnification of a section of a villus. The surface of this villus is covered by a layer of the syncytiotrophoblast consisting of deep violet stained cytoplasm and dark blue stained elongated nuclei. On the surface of the cytoplasm microvilli are conspicuously observed. Beneath the syncytiotrophoblast two cytotrophoblast-cells having a round and clear cytoplasm and a large moderately stained nucleus are recognized (long arrows). Several fetal capillaries attach directly to the syncytio-trophoblast (short arrows); this is a favorable condition for the efficient exchange of nutrient substances in the maternal blood and waste in the fetal blood.

17-006 Mammary Gland

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The mammary glands are paired gland located on the thorax. They provide for the nourishment of the offspring. In the female the glands undergo extensive structural changes associated with puberty, pregnancy, and menopause. They reach their greatest development in about the 20th year, and atrophic changes appear by the 40th year and become marked after menopause.

17-66 Nipple and mammary glands, longitudinal section. Human, H-E stain, x 0.7.

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This is a general view of a longitudinal section of a human resting mammary gland. The mammary gland is a compound tubuloalveolar gland consisting of $20 \sim 30$ lobes drained by the same number of ductus lactiferi that open on the tip of the nipple.



17-67 Nipple, longitudinal section. Human, H-E stain, x 4.0.

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This is the tip of the nipple. Several lactiferous ducts penetrate longitudinally through the nipple. Around each duct encircle numerous smooth muscle fiber bundles. Shortly before opening each duct is slightly dilated to form a lactiferous sinus.



17-68 Mammary gland 1. Resting stage. Human, H-E stain, x 25.

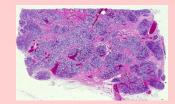
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This is a lobe of the resting mammary gland. Each lactiferous duct divides at its distal end several times into branches with blind ends and remains in this condition during the resting period. The epithelium of the distal portion of the duct consists of two layers of the low cuboidal cells. Each lobe is surrounded by a small amount of connective tissue.separately.



17-69 Mammary gland at term 1. Human, H-E stain, x 2.5.

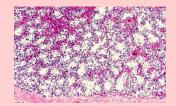


- This is a human mammary gland at term. Each lobe is fully developed and encircled separately by the connective tissue. The connective tissue capsule enclosed the whole glands does not exist.
- Since the beginning of the pregnancy there is a rapid growth in length and branching of the duct system and proliferation of alveoli. This growth of the epithelial components of the gland takes place at the expense of the adipose tissue of the mamma.



17-70 Mammary gland at term 2. Human, H-E stain, x 25.

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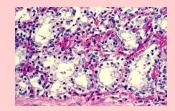


Higher magnification of 17-69. The distended lumen of alveoli is lined by a simple coboidal epithelium consisting of cells with clear cytoplasm. Spaces between the alveoli are densely filled by capillaries containing erythrocytes.



17-71 Mammary gland at term 3. Human, H-E stain, x 100.

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Higher magnification of 17–70. The lumina of alveoli are distended and lined by simple cuboidal cells with clear cytoplasm and deep stained round nucleus. Around the alveoli there are dense capillary network filled by erythrcytes.