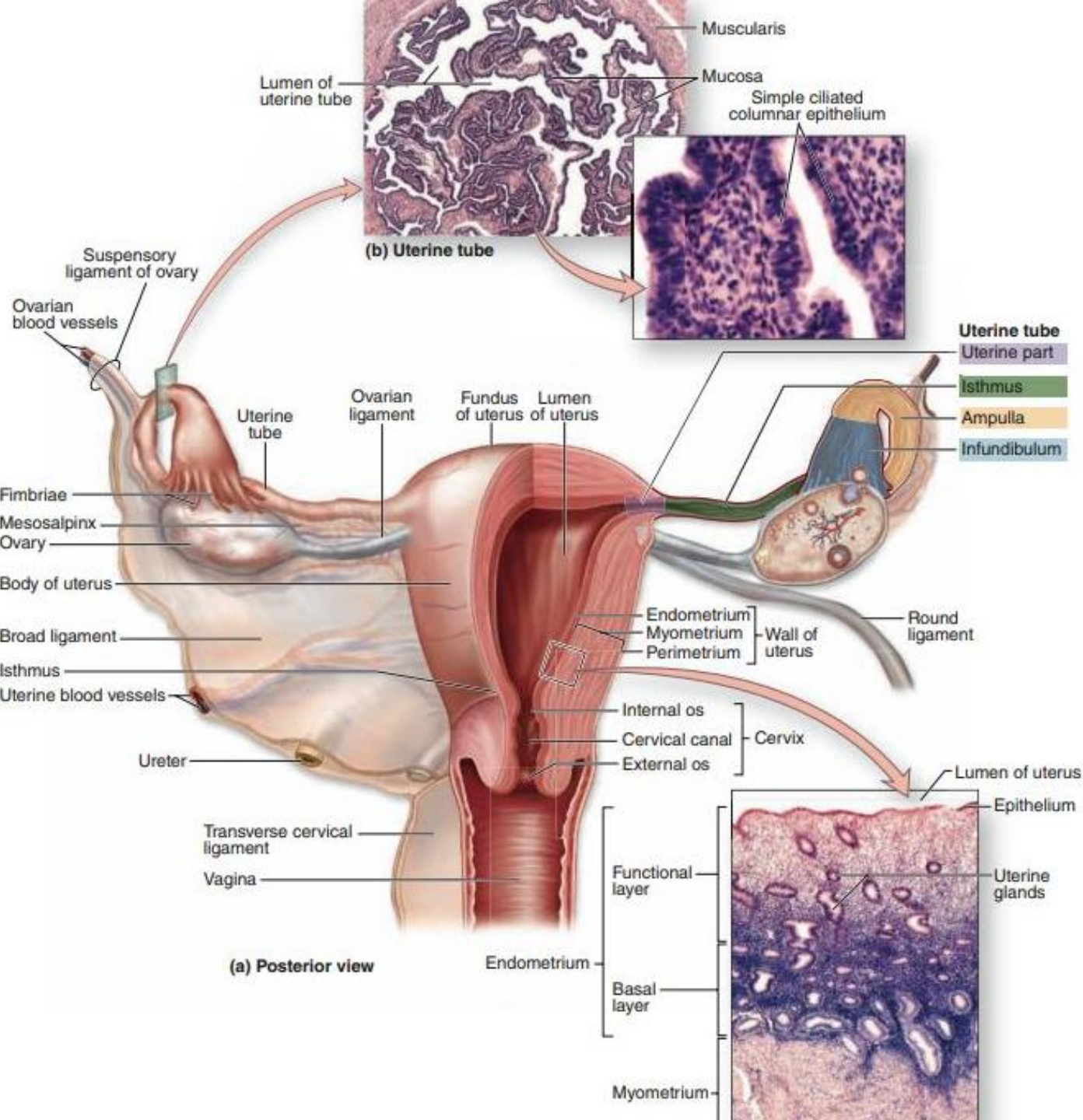


Female Reproductive System

PART 2

Dr. Nassam Emad Daim



The uterine tubes or oviducts are paired ducts that catch the ovulated secondary oocyte, nourish both the oocyte and sperm, provide the microenvironment for fertilization, and transport the embryo undergoing cleavage to the uterus.

(a) The diagram shows the relationship between the uterine tubes and the uterus in an intact posterior view (left) and in a cutaway view (right).

(b) Shown here is a cross section of uterine tube with a high magnification of the mucosa. (X35 and 400; H&E)

(c) Shown here is the uterine wall with the myometrium and the two layers of the endometrium. (X45; H&E)

Endometrium

The mucous membrane of the uterus is called the *endometrium*. The endometrium consists of a lining epithelium that rests on a stroma. Numerous uterine glands are present in the stroma.

The lining epithelium is columnar. Before menarche (i.e., the age of onset of menstruation) the cells are ciliated, but thereafter most of the cells may not have cilia. The epithelium rests on a stroma that is highly cellular and contains numerous blood vessels. It also contains numerous simple tubular uterine glands. The glands are lined by columnar epithelium.

Menstrual Cycle

The endometrium undergoes marked cyclical changes that constitute the *menstrual cycle*. The most prominent feature of this cycle is the monthly flow of blood from the uterus. This is called *menstruation*. The menstrual cycle is divided (for descriptive convenience) into the following phases: *postmenstrual*, *proliferative*, *secretory* and *menstrual*. The cyclical changes in the endometrium take place under the influence of hormones (oestrogen, progesterone) produced by the ovary. They are summarised below.

- In the postmenstrual phase the endometrium is thin. It progressively increases in thickness being thickest at the end of the secretory phase.
- At the time of the next menstruation the greater part of its thickness (called the *pars functionalis*) is shed off and flows out along with the menstrual blood. The part that remains is called the *pars basalis*.
- The uterine glands are straight in the proliferative phase. As the endometrium increases in thickness the glands elongate, increase in diameter, and become twisted on themselves. Because of this twisting, they acquire a saw-toothed appearance in sections Fig.

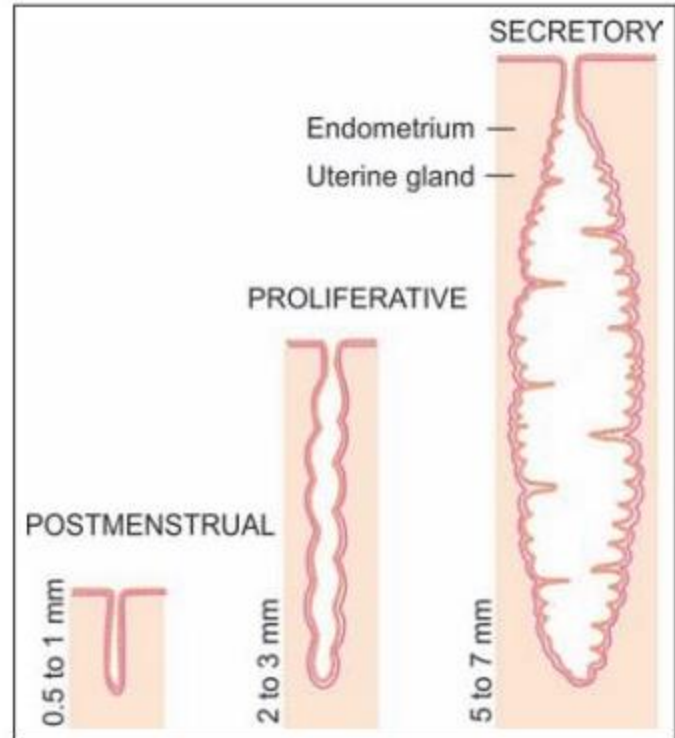


Fig. Uterine glands at various stages of menstrual cycle. The thickness of endometrium is also indicated (Schematic representation)

- At the time of menstruation the greater parts of the uterine glands are lost (along with the entire lining epithelium) leaving behind only their most basal parts.
- The lining epithelium is reformed (just after the cessation of menstruation) by proliferation of epithelial cells in the basal parts of the glands.
- The stroma and blood vessels of the endometrium also undergo cyclical changes.

Added Information

Hormones influencing Ovulation and Menstruation

We have seen that the changes taking place in the uterine endometrium during the menstrual cycle occur under the influence of:

- ❑ Oestrogens produced by the thecal gland (theca interna) and by the interstitial gland cells, and possibly by granulosa cells.
- ❑ Progesterone produced by the corpus luteum.

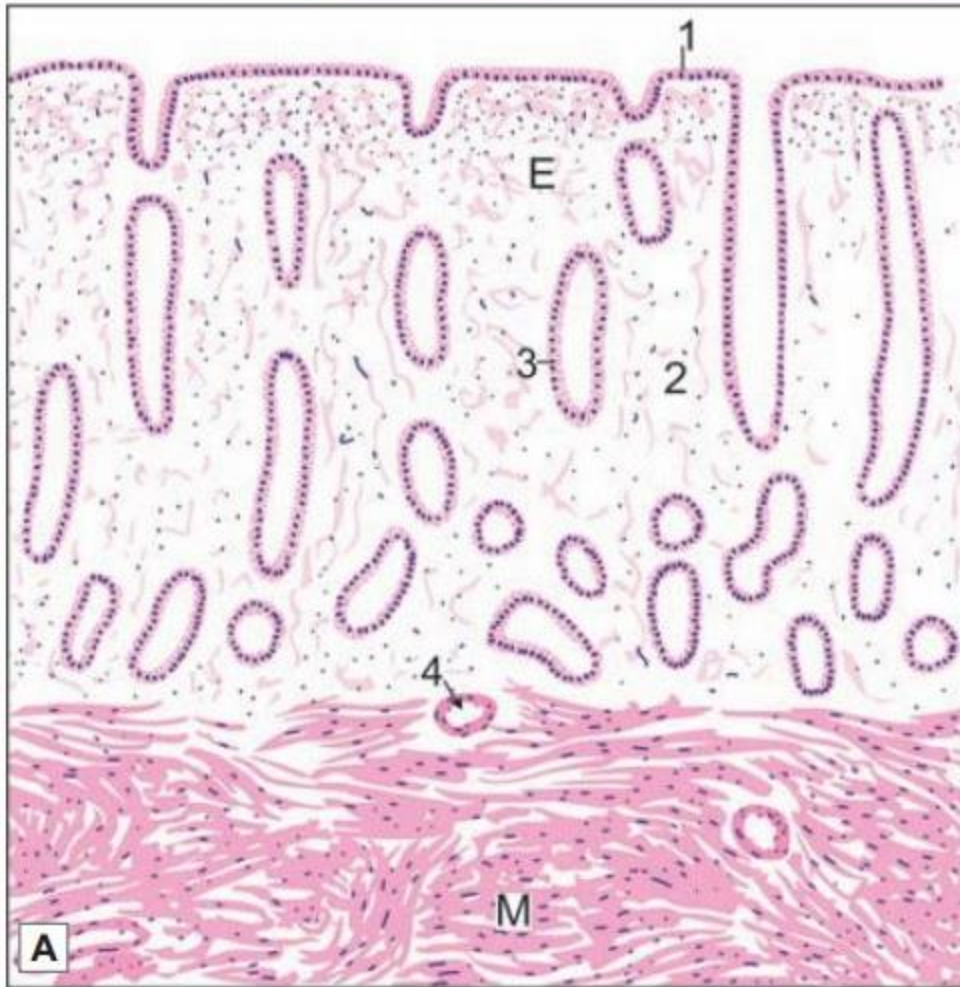
The development of the ovarian follicle, and of the corpus luteum, is in turn dependent on hormones produced by the anterior lobe of the hypophysis cerebri. These are:

- ❑ The **follicle stimulating hormone** (FSH) which stimulates the formation of follicles and the secretion of oestrogens by them; and
- ❑ The **luteinising hormone** (LH) which helps to convert the ovarian follicle into the corpus luteum, and stimulates the secretion of progesterone.

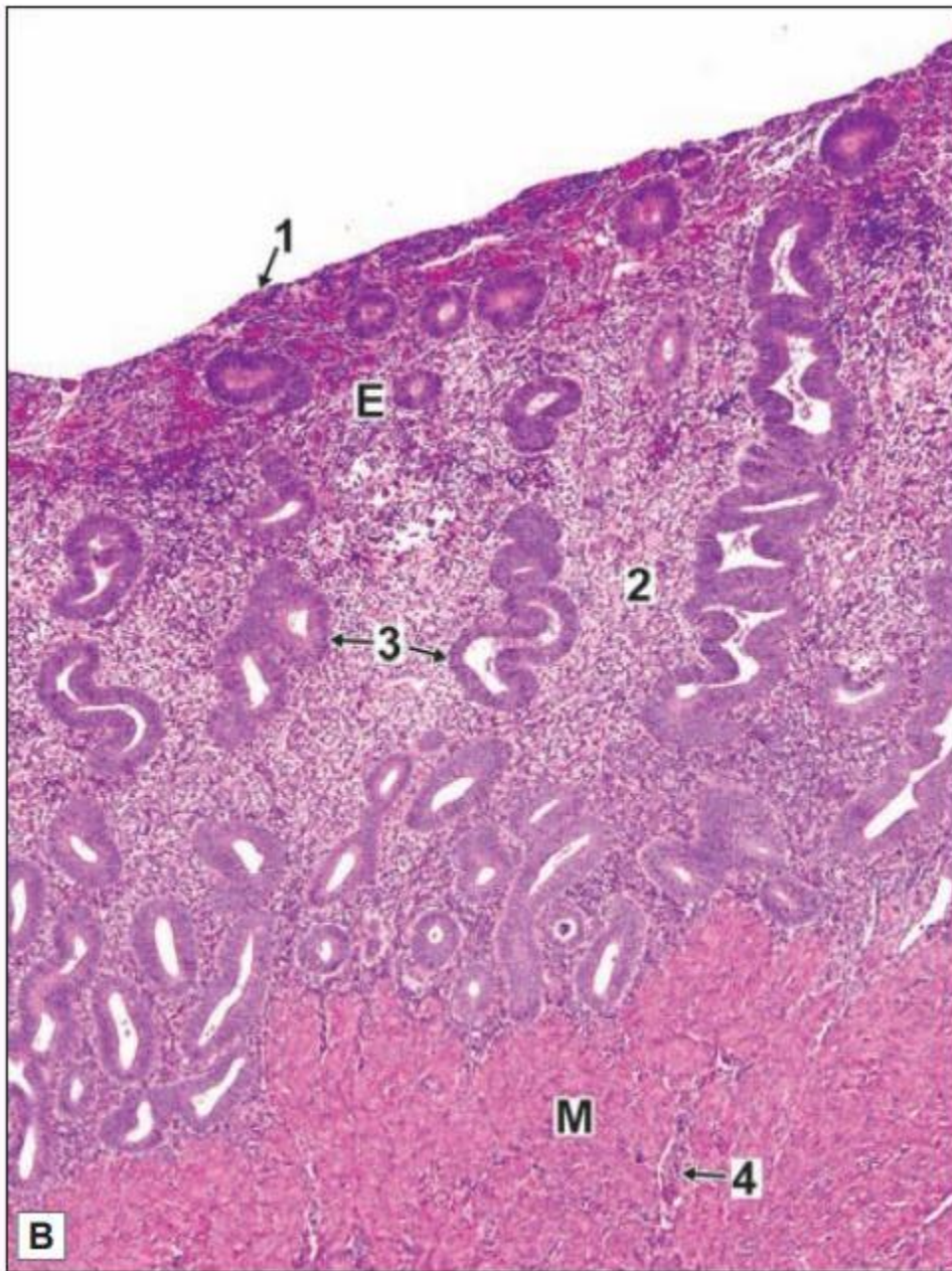
Secretion of FSH and LH is controlled by a **gonadotropin releasing hormone** (GnRH) produced by the hypothalamus. Production of LH is also stimulated by feed back of oestrogens secreted by follicular cells of the ovary. A sudden increase (surge) in the level of LH takes place near the middle of the menstrual cycle, and stimulates ovulation that takes place about 36 hours after the surge.

Apart from hormones, nervous and emotional influences may affect the ovarian and menstrual cycles. An emotional disturbance may delay or even prevent menstruation.

Uterus (Proliferative Phase)



- ❑ The wall of the uterus consists of a mucous membrane (called the endometrium) and a very thick layer of muscle (the myometrium). The thickness of the muscle layer helps to identify the uterus easily
- ❑ The endometrium has a lining of columnar epithelium that rests on a stroma of connective tissue
- ❑ Numerous tubular uterine glands dip into the stroma
- ❑ The appearance of the endometrium varies considerably depending upon the phase of the menstrual cycle
 - The endometrium is thin and progressively increases in thickness
 - The uterine glands are straight and tubular in this phase.

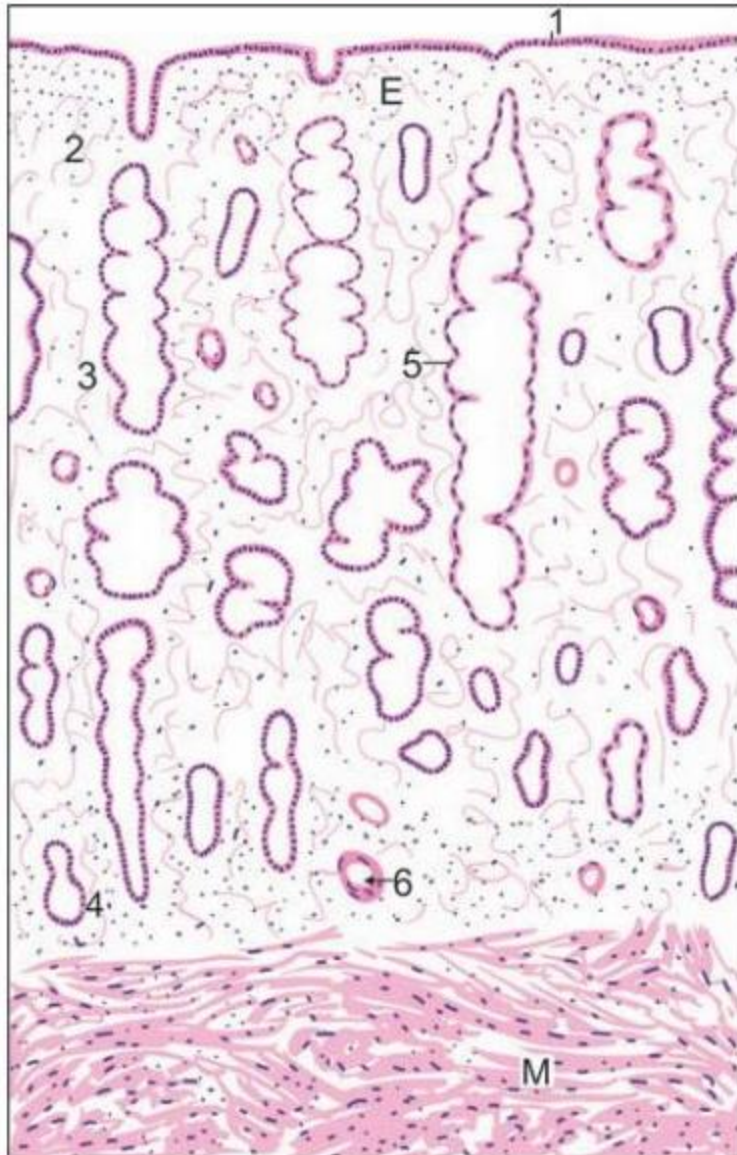


Key

1. Columnar epithelium
 2. Connective tissue
 3. Uterine glands
 4. Blood vessels
- E. Endometrium
M. Myometrium

Uterus secretory phase. A. As seen in drawing;
B. Photomicrograph

Uterus Secretory Phase



In the secretory phase

- The thickness of the endometrium is much increased
- The uterine glands elongate, become dilated, and tortuous as a result of which they have saw-toothed margins in sections
- Blood vessels extend in the upper portion of endometrium.

Note: In this phase the appearance of the endometrium becomes so distinctive that the uterus cannot be confused with any other organ.

Key

1. Columnar epithelium
 2. Stratum compactum
 3. Stratum spongiosum
 4. Stratum basale
 5. Enlarged uterine gland
 6. Blood vessel
- E. Endometrium
M. Myometrium

Uterus secretory phase (As seen in drawing)

Cervix

The cervix is narrow lower part of uterus. The cavity of cervix (cervical canal) is narrow and communicates with the uterine cavity at its upper end and with vagina at its lower end. The upper and lower openings are referred to as internal and external os respectively. The lower portion of cervix which projects into vagina is called as *portio vaginalis*.

The structure of the cervix of the uterus is somewhat different from that of the body. Here the mucous membrane (or *endocervix*) has a number of obliquely placed *palmate folds*. It contains deep branching glands that secrete mucous. The mucosa also shows small cysts that probably represent glandular elements that are distended with secretion. These cysts are called the *ovula Nabothi*.

The mucous membrane of the upper two thirds of the cervical canal is lined by ciliated columnar epithelium, but over its lower one third the epithelium is non-ciliated columnar. Near the external os the canal is lined by stratified squamous epithelium. The part of the cervix that projects into vagina has an external surface that is covered by stratified squamous epithelium. The stroma underlying the epithelium of the cervix is less cellular than that of the body of the uterus and does not show muscle coat.

The lumen of the cervix is normally a narrow canal. It has tremendous capacity for dilation and, at the time of child birth, it becomes large enough for the fetal head to pass through.

VAGINA

The vagina is a fibromuscular elastic tube that extends from lower part of the cervix to the external genitalia. It is about 8 cm long. It is capable of considerable elongation and distension, this being helped by the rich network of elastic fibres in its wall. The wall of the vagina consists of following three layers

Mucous Membrane

The mucous membrane shows numerous longitudinal folds, and is firmly fixed to the underlying muscle layer. It is lined by stratified squamous epithelium (nonkeratinised). The epithelial cells are rich in glycogen. (The glycogen content shows cyclical variation during the menstrual cycle).

The epithelium rests on dense connective tissue (lamina propria) that is highly vascular, many veins being present. The tissue is rich in elastic fibres. No glands are seen in the mucosa, the vaginal surface being kept moist by secretions of glands in the cervix of the uterus.

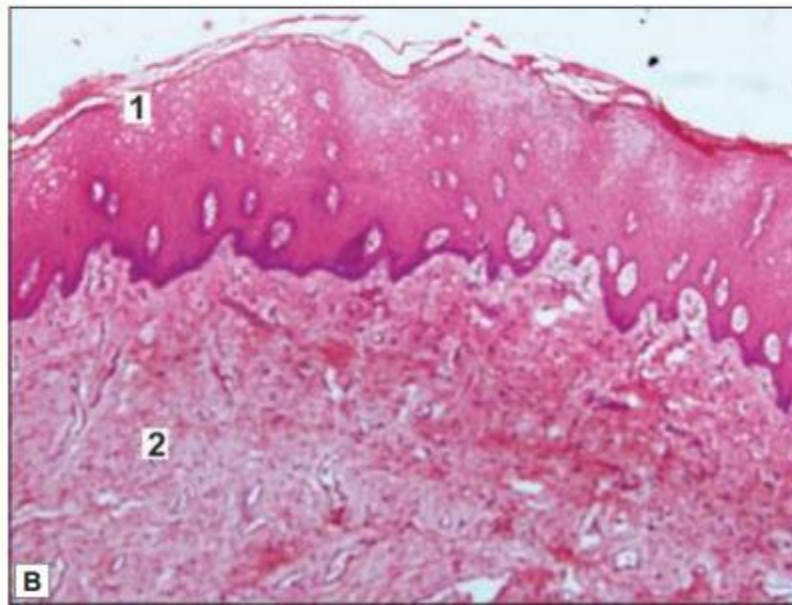
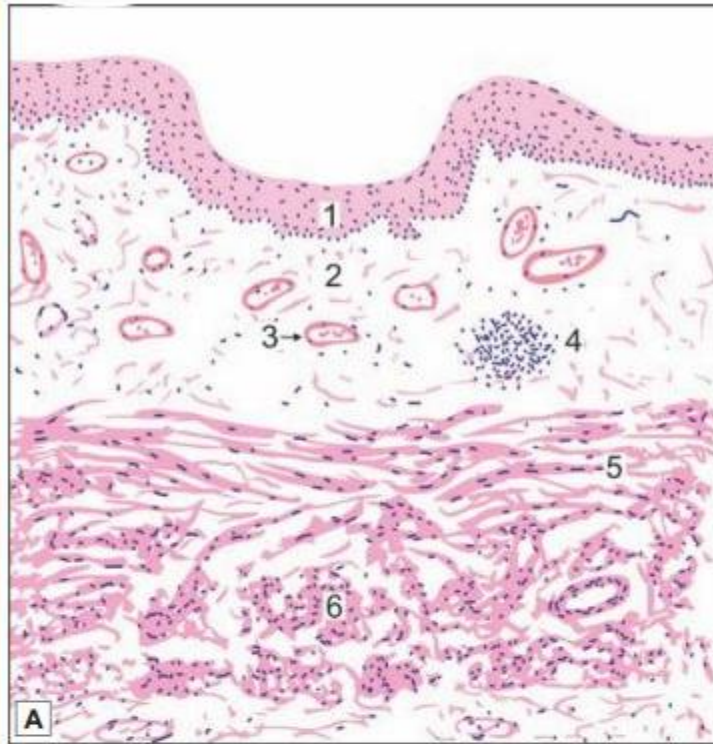
Muscle Coat

The muscle coat is made up of an outer layer of longitudinal fibres, and a much thinner inner layer of circular fibres. Many elastic fibres are present among the muscle fibres. The lower end of the vagina is surrounded by striated muscle fibres that form a sphincter for it.

Adventitia

The muscle wall is surrounded by an adventitia made up of fibrous tissue containing many elastic fibres.

Vagina



- *The vagina is a fibromuscular structure consisting of an inner mucosa, a middle muscular layer and an outer adventitia.
- *The mucosa consists of stratified squamous non-keratinised epithelium and loose fibro-elastic connective tissue lamina propria with many blood vessels and no glands.
- *The mucosa of vagina is rich in glycogen and hence the cells are pale stained which distinguishes it from esophagus.
- *Muscular layer consists of smooth muscle fibers.

Key

1. Lining of stratified squamous epithelium
2. Lamina propria
3. Blood vessel
4. Lymphoid follicle
5. Muscle coat (circular)
6. Muscle coat (longitudinal)

MAMMARY GLAND

Although the mammary glands are present in both sexes they remain rudimentary in the male. In the female, they are well developed after puberty. Each breast is a soft rounded elevation present over the pectoral region. The skin over the centre of the elevation shows a darkly pigmented circular area called the **areola**. Overlying the central part of the areola there is a projection called the **nipple**.

Each mammary gland has an outer covering of skin deep to which there are several discrete masses of glandular tissue. These masses are separated (and covered) by considerable quantities of connective tissue and of adipose tissue . The fascia covering the gland is connected to overlying skin by fibrous processes called the **suspensory ligaments** (of Cooper). (In cancer of the breast these processes contract causing pitting of the overlying skin).

The glandular tissue (or mammary gland proper) is made up of 15 to 20 lobes. Each lobe consists of a number of lobules. The lobules are separated by moderately dense collagenous interlobular connective tissue. The lobule consists of many alveoli. The alveoli are embedded in loose cellular connective tissue (intralobular connective tissue).

The cells lining the alveoli vary in appearance in accordance with functional activity. In the 'resting' phase they are cuboidal. When actively producing secretion the cells become columnar. When the secretion begins to be poured into the lumen, distending them, the cells again become cuboidal, but are now much larger. The cells are filled with secretory vacuoles. Some distance from its termination each lactiferous duct shows a dilation called the **lactiferous sinus**.

Ducts System

Each lobe drains into a **lactiferous duct** that opens at the summit of the nipple . Beneath the nipple, the lactiferous duct dilates into **lactiferous sinus**, which functions as a reservoir of milk. The smaller ducts are lined by columnar epithelium. In the larger ducts

Textbook of Human Histology

the epithelium has two or three layers of cells. Near their openings on the nipple the lining becomes stratified squamous. Between the epithelium and the basement membrane of the ducts, myoepithelial cells are present.

Nipple and Areola

The nipple is covered by keratinised stratified squamous epithelium. It consists of dense connective tissue and smooth muscles arranged circularly and longitudinally. The pigmented skin around the nipple is called

areola. The skin of the areola lacks hair follicles. Circular smooth muscle is present in the dermis of the areola. Contraction of this muscle causes erection of the nipple. Many sebaceous glands and apocrine sweat glands are also present in the areola. At the periphery of the areola there are large sebaceous glands that are responsible for the formation of surface elevations called the **tubercles of Montgomery**.

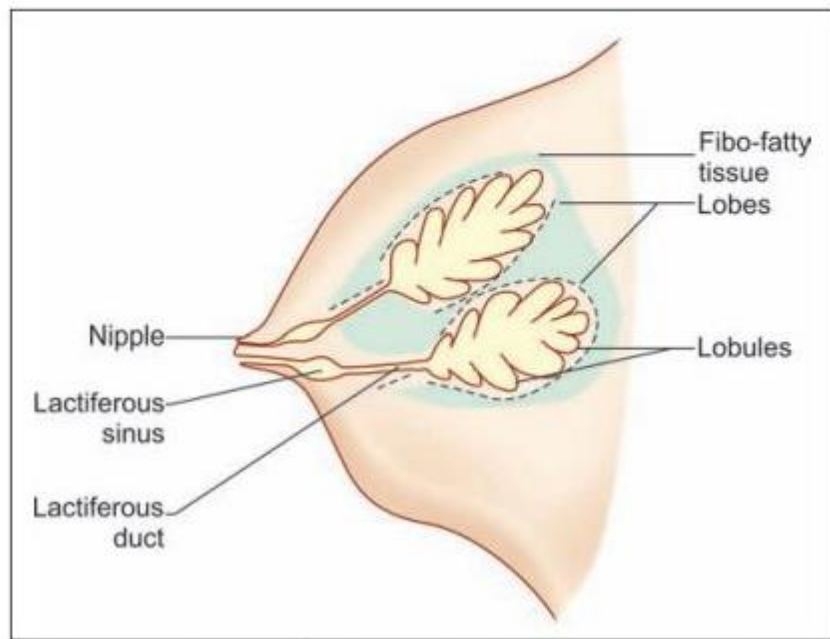


Fig. : Human female breast (Schematic representation)

Added Information

- ❑ In the resting mammary gland, glandular epithelium is surrounded by an avascular zone containing fibroblasts. It has been claimed that this zone constitutes an **epithelio-stromal junction** that controls passage of materials to glandular cells.
- ❑ In the male, the mammary gland is rudimentary and consists of ducts that may be represented by solid cords of cells. The ducts do not extend beyond the areola.

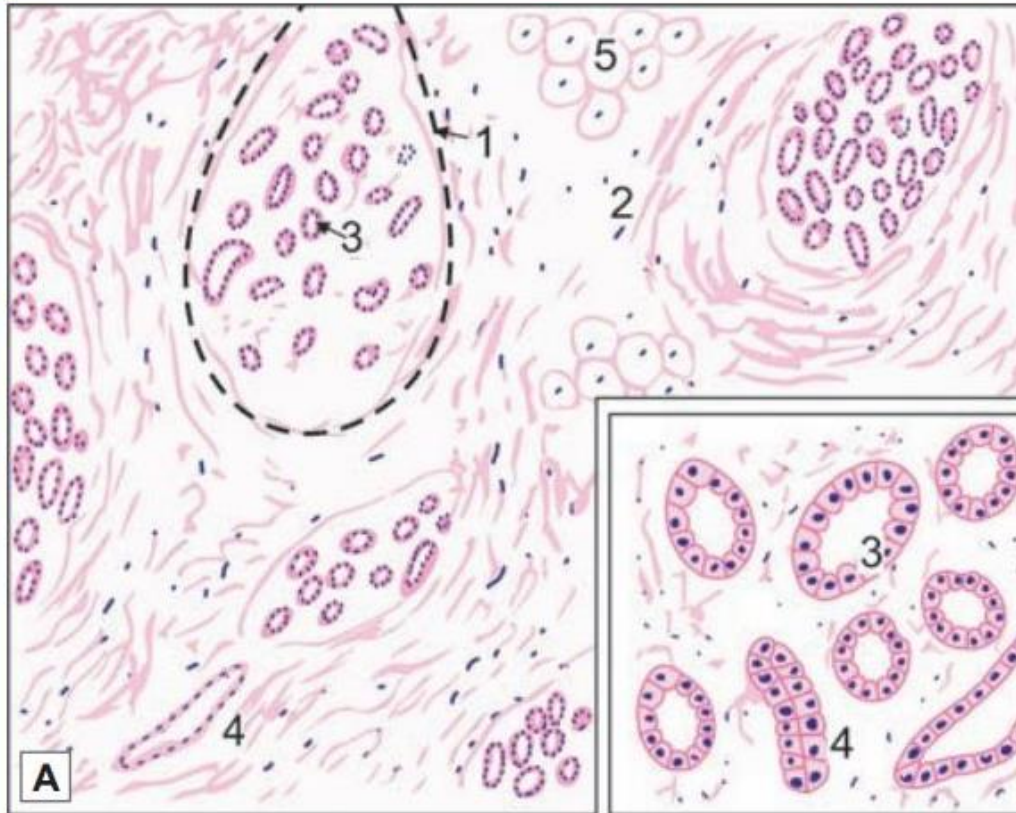
Structure of Glandular Elements

The structure of the glandular elements of the mammary gland varies considerably at different periods of life as follows:

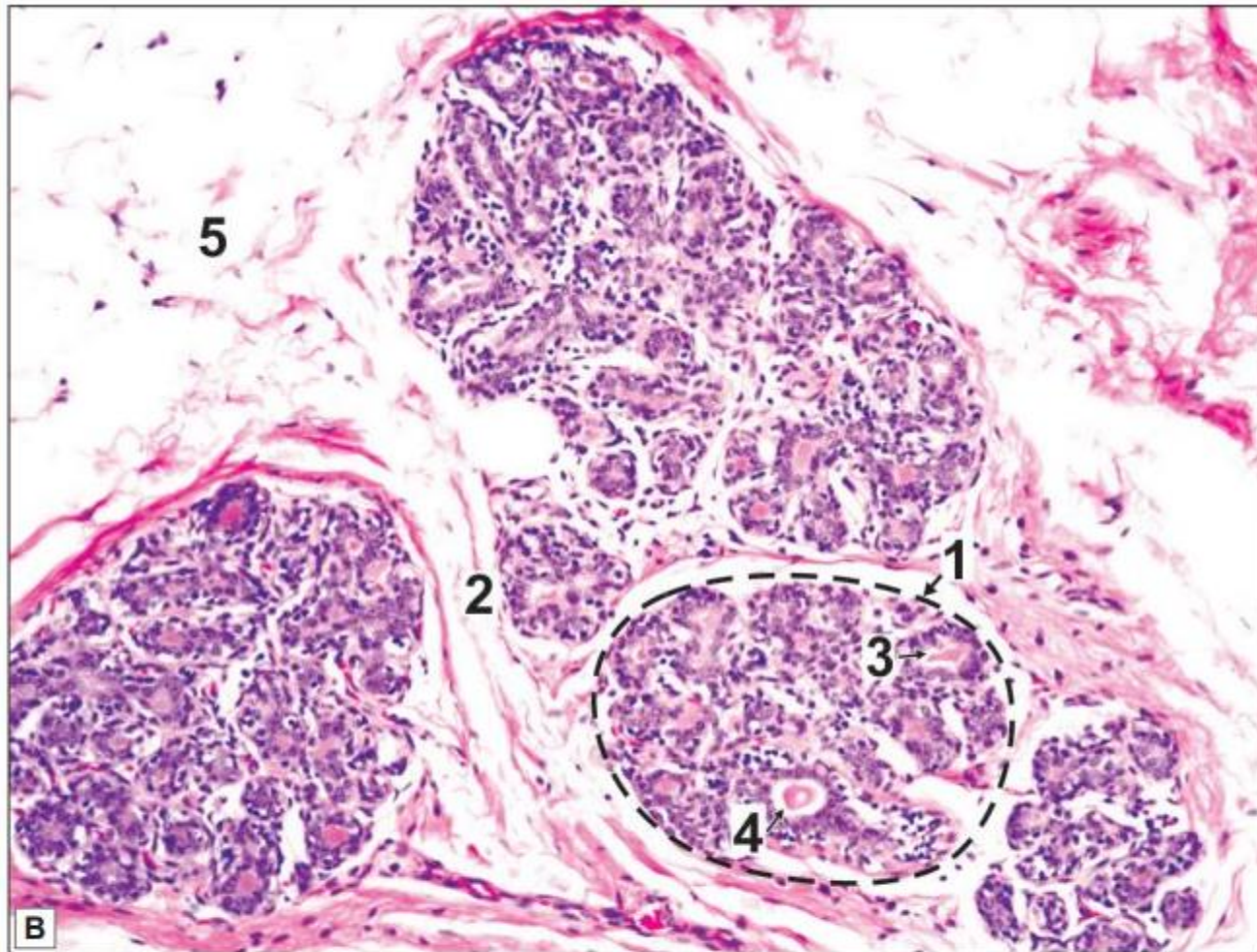
- ❑ Before the onset of puberty the glandular tissue consists entirely of ducts. Between puberty and the first pregnancy the duct system proliferates. At the end of each duct solid masses of polyhedral cells are formed, but proper alveoli are few or absent. The bulk of the breast consists of connective tissue and fat that widely separate the glandular elements.
- ❑ During pregnancy the ducts undergo marked proliferation and branching. Their terminal parts develop into proper alveoli. Each lobe is now a compound tubulo-alveolar gland. The ducts and alveoli are surrounded by very cellular periductal tissue. Towards the end of pregnancy the cells of the alveoli start secreting milk and the alveoli become distended.

The development of breast tissue during pregnancy takes place under the influence of hormones produced by the hypophysis cerebri. Cells lining glandular tissue bear receptors for these hormones.

Mammary Gland (Resting)



- ❑ Mammary gland consists of lobules of glandular tissue separated by considerable quantity of connective tissue and fat
- ❑ Non lactating mammary glands contain more connective tissue and less glandular tissue
- ❑ The glandular elements or alveoli are distinctly tubular. They are lined by cuboidal epithelium and have a large lumen so that they look like ducts. Some of them may be in form of solid cords of cells
- ❑ Extensive branching of duct system seen.

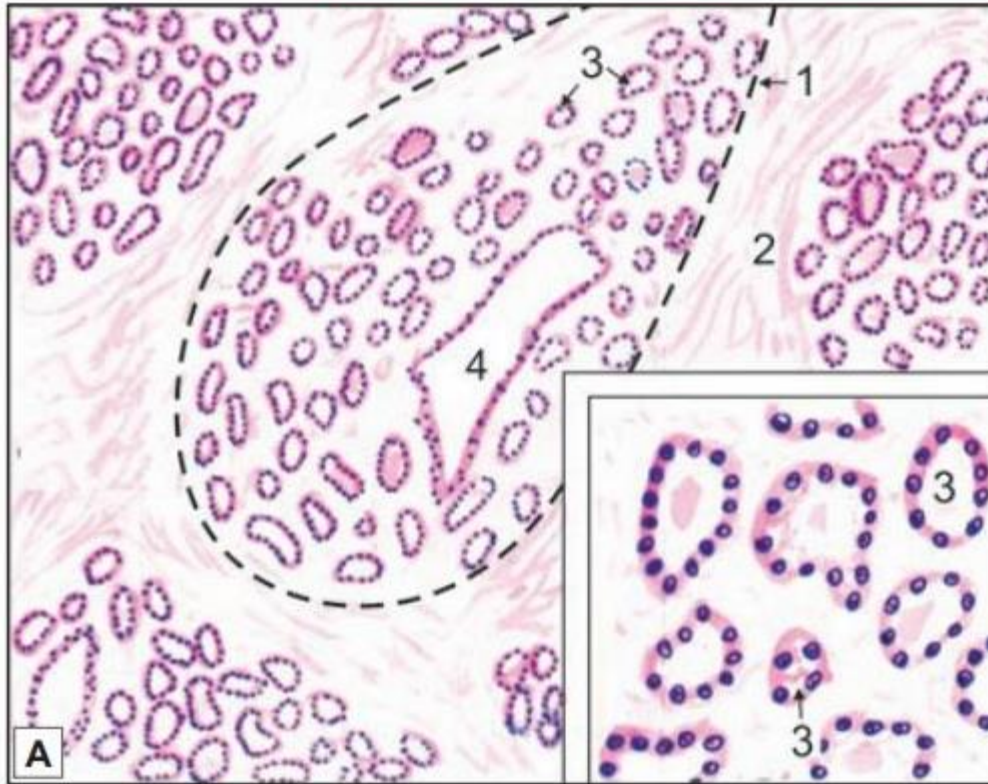


Mammary gland (resting) A. As seen in drawing; B. Photomicrograph

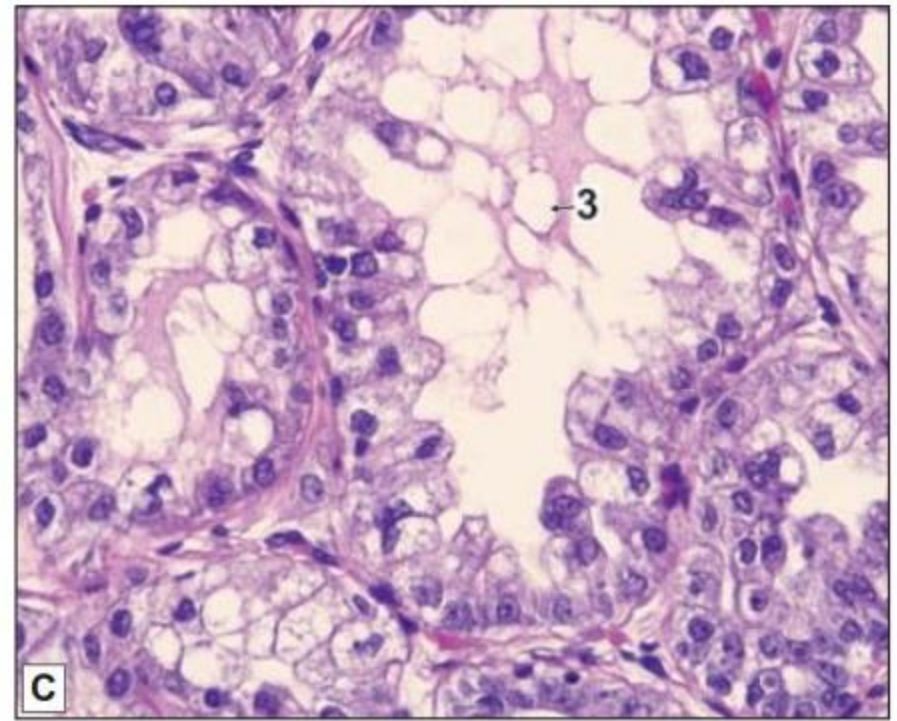
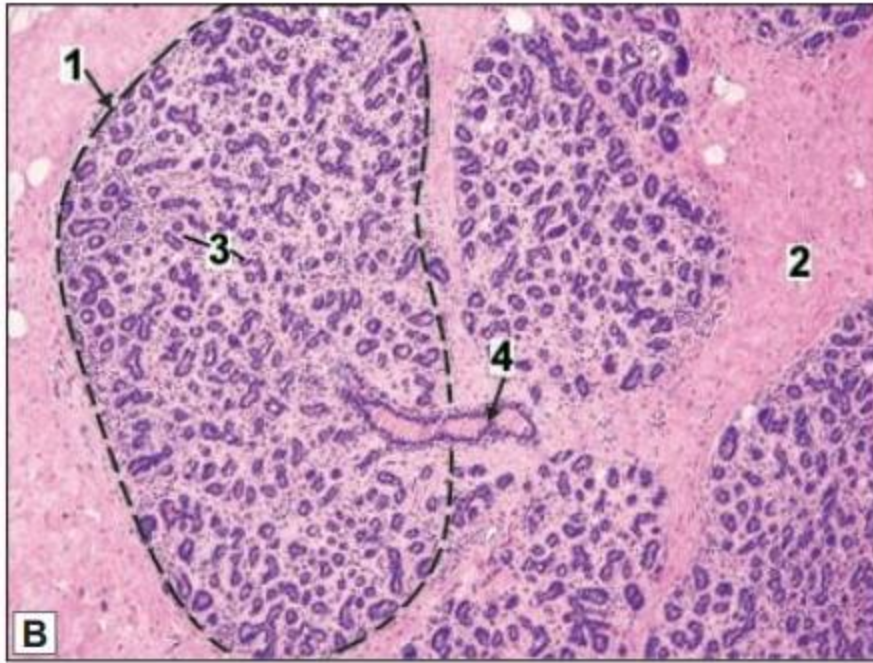
Key

- | | |
|----------------------|-------------------|
| 1. Lobule | 4. Duct |
| 2. Connective tissue | 5. Adipose tissue |
| 3. Alveoli | |

Mammary Gland (Lactating)



- ❑ In lactating mammary gland the glandular elements proliferate so that they become relatively more prominent than the connective tissue
- ❑ The interlobular connective tissue septum is very thin
- ❑ The lobules are formed by compactly arranged alveoli
- ❑ The alveoli are lined by simple cuboidal secretory epithelium and associated myoepithelial cells. Their lumen contains eosinophilic secretory material which appear vacuolated due to the presence of fat droplets.



Mammary gland (Lactating). A. As seen in drawing; B. Photomicrograph (low magnification); C. Photomicrograph (high magnification)

Courtesy: Atlas of Histopathology. 1st Edition. Ivan Damjanov. Jaypee Brothers. 2012. p259

Key

- | | |
|----------------------|------------|
| 1. Lobule | 3. Alveoli |
| 2. Connective tissue | 4. Duct |

- ❑ During lactation the glandular tissue is much more prominent than before, and there is a corresponding reduction in the volume of the connective tissue and fat
- ❑ When lactation ceases the glandular tissue returns to the resting state. It undergoes atrophy after menopause (i.e., the age after which menstruation ceases).