

## *Chapter 15:*

### *Regulation of the Female Sexual Hormones*

- *Document 1: The Sexual Cycle*
- **Document 2:** *Cyclic Evolution of the Ovarian Hormones*
- *Document 3: Hypothalamo-pituitary axis and Ovarian Hormones*
- *Document 4: Ovarian Feedback Control on the Hypothalamo-Pituitary Axis*
- *Selected Exercises of the Official Exams*

# Document 2: Cyclic Evolution of the Ovarian Hormones

## I. Endocrine Function of the Ovaries:

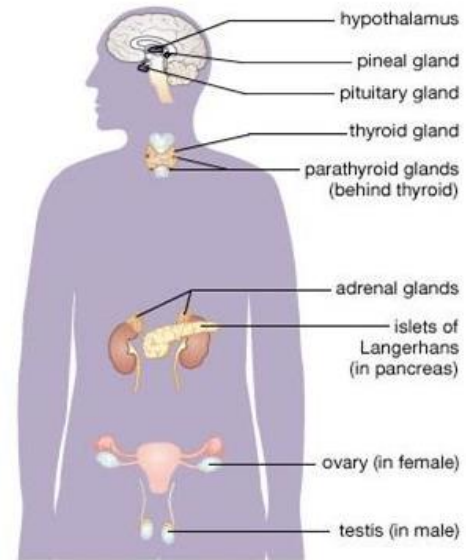
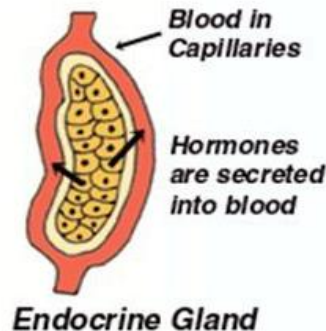
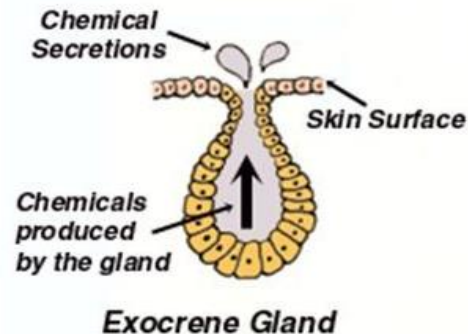
- **Gland:** is a group of secretory cells. They can be classified into exocrine and endocrine glands.

- **Endocrine** glands produce and secrete hormones into the bloodstream

- eg. the pituitary gland

- **Exocrine** glands secrete through ducts

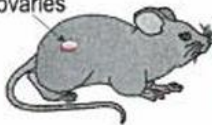


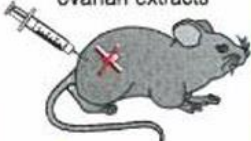
- eg. salivary glands



## - Application 1:

Document a shows experiments representing the relationship between the ovaries and the uterus.

### 1 Endocrine function of the ovaries




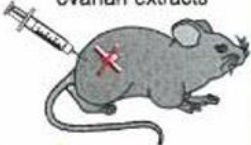
| experimental conditions           | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
|-----------------------------------|---|--|---|--|
| results obtained<br>in the uterus | cyclic development<br>of the endometrium  | no development<br>of the endometrium   | cyclic development<br>of the endometrium  | development of the<br>endometrium with<br>no cyclic variations   |

*Doc.a Experiments representing the relationship between the ovaries and the uterus.*

#### 1- Indicate the aim of the experiment.

To study the relationship between the ovaries and the uterus.

## 1 Endocrine function of the ovaries





|                                   |   |  |   |  |
|-----------------------------------|---|--|---|--|
| experimental conditions           | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
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**Doc.a** Experiments representing the relationship between the ovaries and the uterus.

## 2- Pose the studied problem.

What is the relationship between the ovaries and the uterus?

## 1 Endocrine function of the ovaries




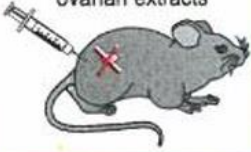
|                                |   |  |   |  |
|--------------------------------|---|--|---|--|
| experimental conditions        | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
| results obtained in the uterus | cyclic development of the endometrium   | no development of the endometrium  | cyclic development of the endometrium   | development of the endometrium with no cyclic variations   |

*Doc.a Experiments representing the relationship between the ovaries and the uterus.*

### 3- Interpret experiments 1 and 2.

In a lot of control mice having the 2 ovaries, there is a cyclic development of the endometrium. While, upon performing bilateral ovariectomy (removal of both ovaries), there is no development of the endometrium. This means that ovaries promote the development of the endometrium.

## 1 Endocrine function of the ovaries

|                                   |   |  |   |  |
|-----------------------------------|---|--|---|--|
| experimental conditions           | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
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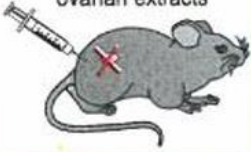
**Doc.a** Experiments representing the relationship between the ovaries and the uterus.

### 4- Interpret experiment 3.

Upon performing ovariectomy then graft of the ovaries under the skin, there is cyclic development of the endometrium.

This means that ovaries stimulate the endometrial development through blood (endocrine function).

## 1 Endocrine function of the ovaries

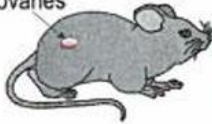



|                                   |   |  |   |  |
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| experimental conditions           | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
| results obtained<br>in the uterus | cyclic development<br>of the endometrium  | no development<br>of the endometrium   | cyclic development<br>of the endometrium  | development of the<br>endometrium with<br>no cyclic variations   |

**Doc.a** Experiments representing the relationship between the ovaries and the uterus.

### 5- Interpret experiment 4.

Upon performing ovariectomy then daily constant injection of ovarian extracts, there is development of the endometrium with no cyclic variations. This means that ovaries secrete hormones in a variable manner (periodically) to promote the cyclic development of the endometrium (uterus).

## 1 Endocrine function of the ovaries

|                                   |   |  |   |  |
|-----------------------------------|---|--|---|--|
| experimental conditions           | a lot of control mice<br>ovaries<br> | bilateral ovariectomy<br>(removal of both ovaries)<br> | ovariectomy then graft<br>of the ovaries<br>under the skin<br> | ovariectomy then daily<br>constant injection of<br>ovarian extracts<br> |
| results obtained<br>in the uterus | cyclic development<br>of the endometrium  | no development<br>of the endometrium   | cyclic development<br>of the endometrium  | development of the<br>endometrium with<br>no cyclic variations   |

*Doc.a Experiments representing the relationship between the ovaries and the uterus.*

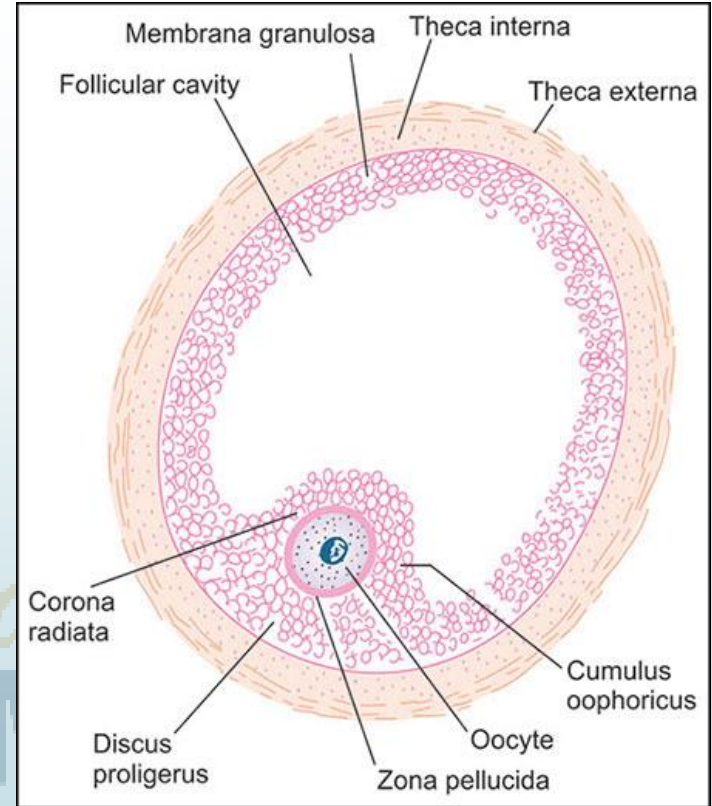
**6- Draw out a conclusion concerning the relationship between ovaries and the uterus.**

Thus, ovaries secrete hormones periodically through blood to control the cyclic development of the uterus (endometrium).

Ovaries have endocrine function.

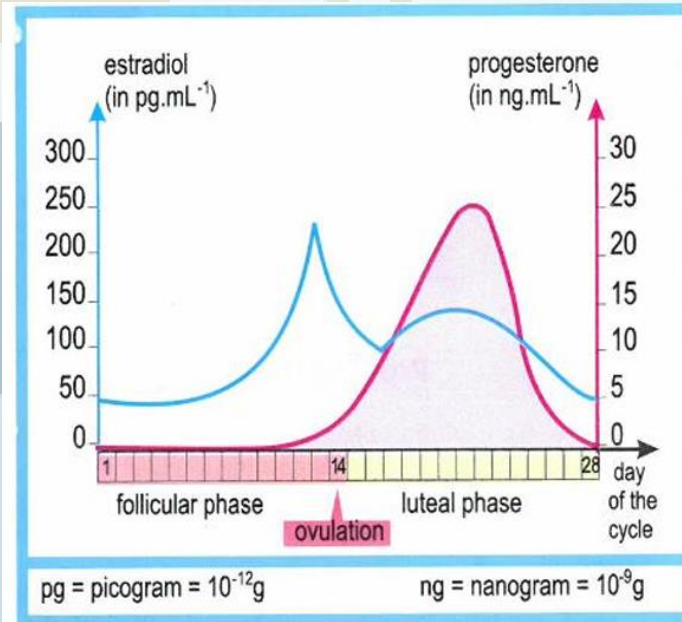
## II. Ovarian Hormones:

- Ovaries secrete two sexual hormones: **estrogen and progesterone.**
- Granulosa is a layer of cells surrounding the ovarian follicle. Theca interna is a layer of cells surrounding granulosa.



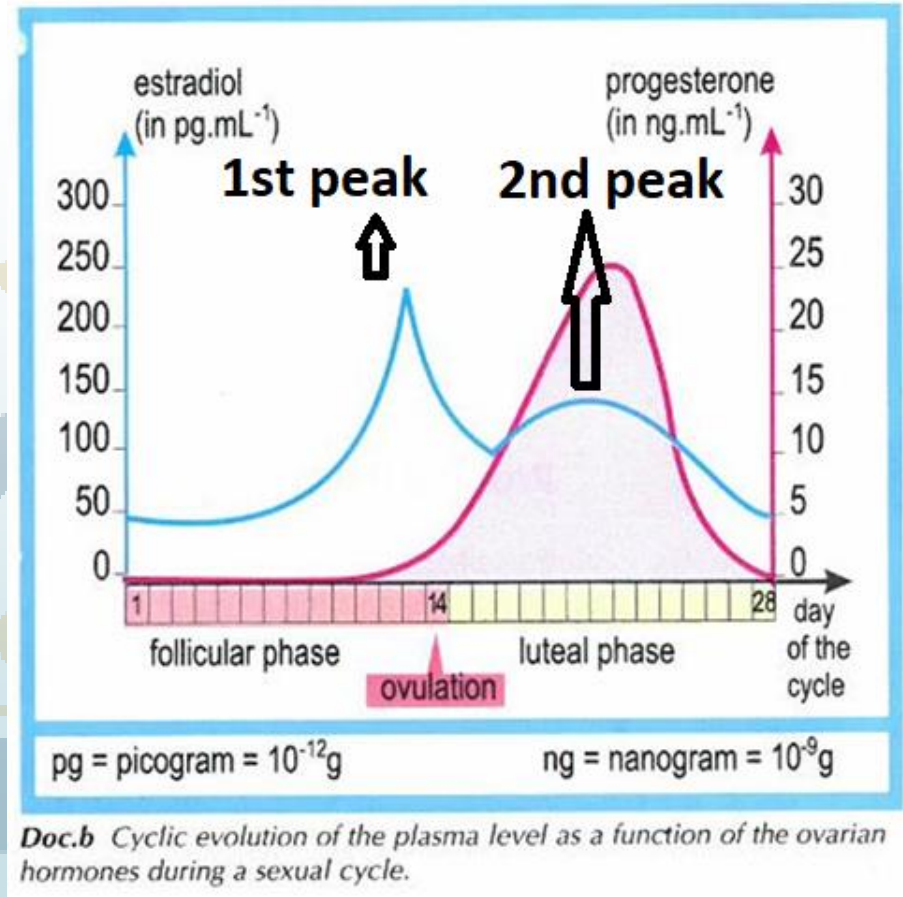
## \* Estrogen is secreted by:

- Cells of granulosa and theca interna during the **follicular phase**.
  - and by cells of the corpus luteum during the **luteal phase**.
- ⇒ Estrogen has two peaks throughout the cycle: Doc b



**Doc.b** Cyclic evolution of the plasma level as a function of the ovarian hormones during a sexual cycle.

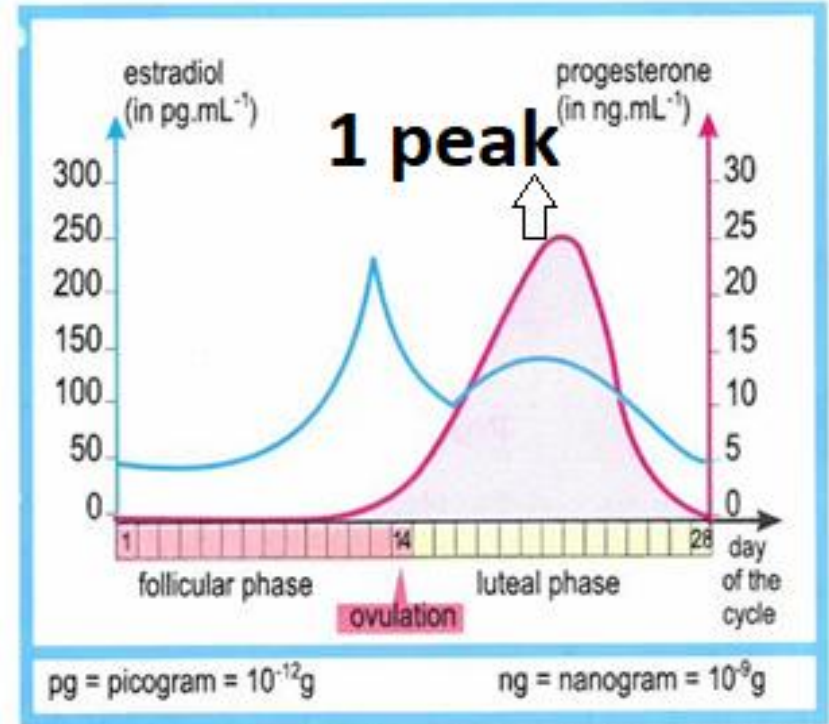
- ☞ The **first peak** occurs few hours before ovulation where it is secreted by the mature graafian follicle which is ready to ovulate.
- ☞ The **second peak** occurs during the luteal phase on day 21, since there is maximum development of the corpus luteum.



## \*Progesterone is secreted by:

- The cells of the corpus luteum during the **luteal phase**.

⇒ Progesterone has **1 peak** only during the luteal phase at day 21 where there is maximum development of the corpus luteum.



*Doc.b* Cyclic evolution of the plasma level as a function of the ovarian hormones during a sexual cycle.

- ***Function / Effect of the Ovarian hormones estrogen and progesterone:***  
Study Doc c.
- ***Uterine mucosa= endometrium***

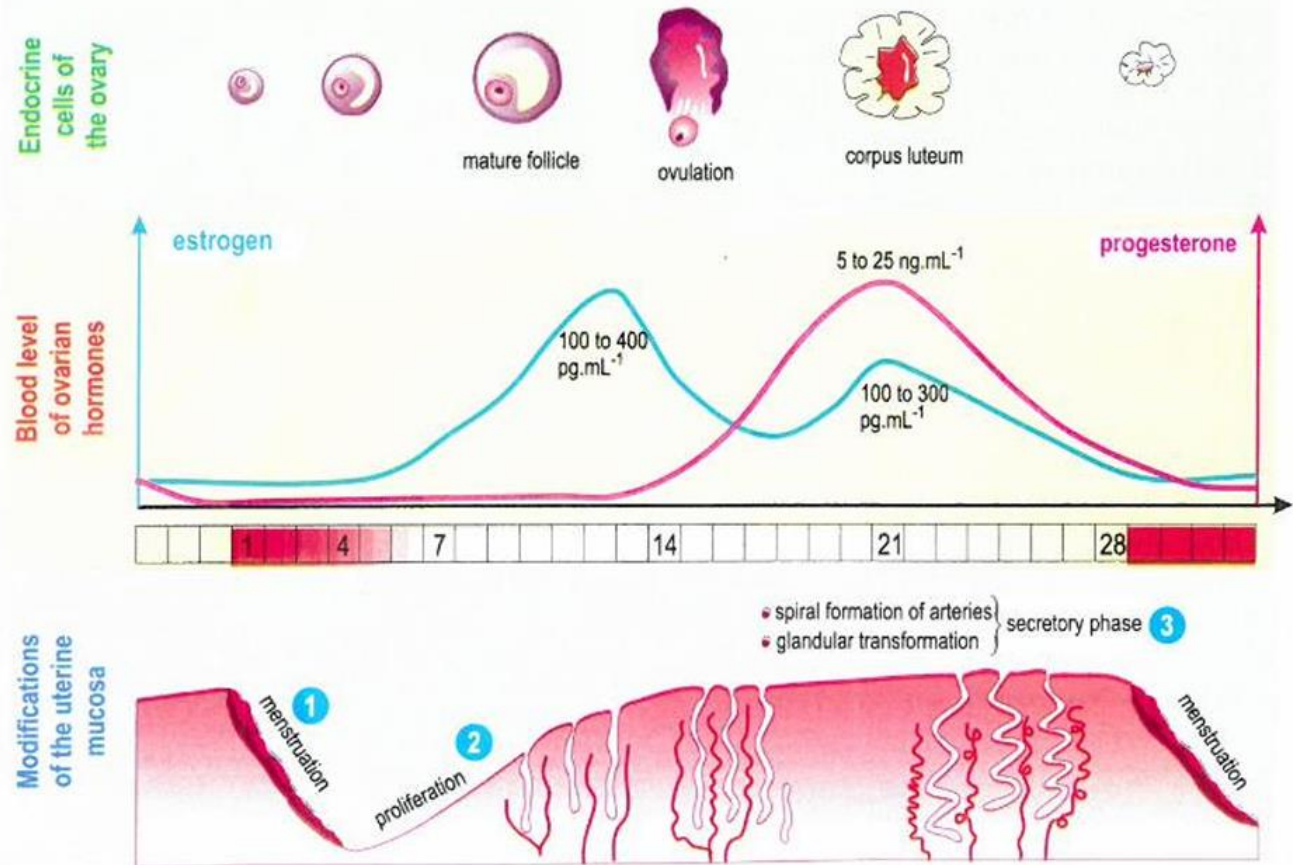
| Estrogen  | Progesterone  |
|---|---|
| <ul style="list-style-type: none"><li>- Proliferation of the uterine and vaginal mucosa</li><li>- Development of the tube-like glands of the endometrium</li><li>- Development of the cervical glands</li><li>- Growth of the blood vessels</li></ul> | <ul style="list-style-type: none"><li>- Stimulation of gland secretions in the uterine mucosa and the cervix</li><li>- Development of spiral arterioles</li><li>- Increase in the body temperature</li><li>- Inhibition of the uterine contractions</li></ul> |

**Doc.c** Main biological effects of the ovarian hormones.

ACADEMY

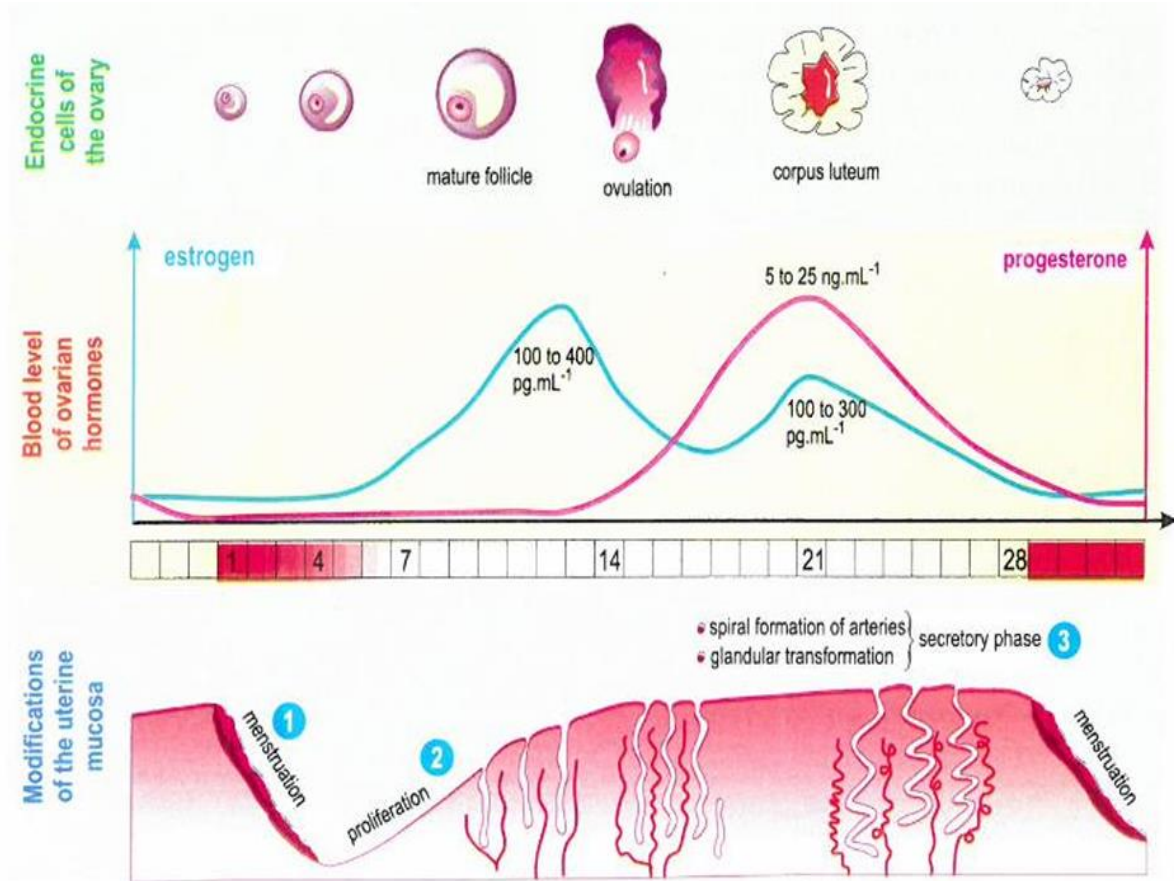
### III. Synchronism of the Ovarian and Uterine Cycles:

*-Explain how the cyclic secretions of ovarian hormones affect the cyclic evolution of uterine mucosa. Doc d*



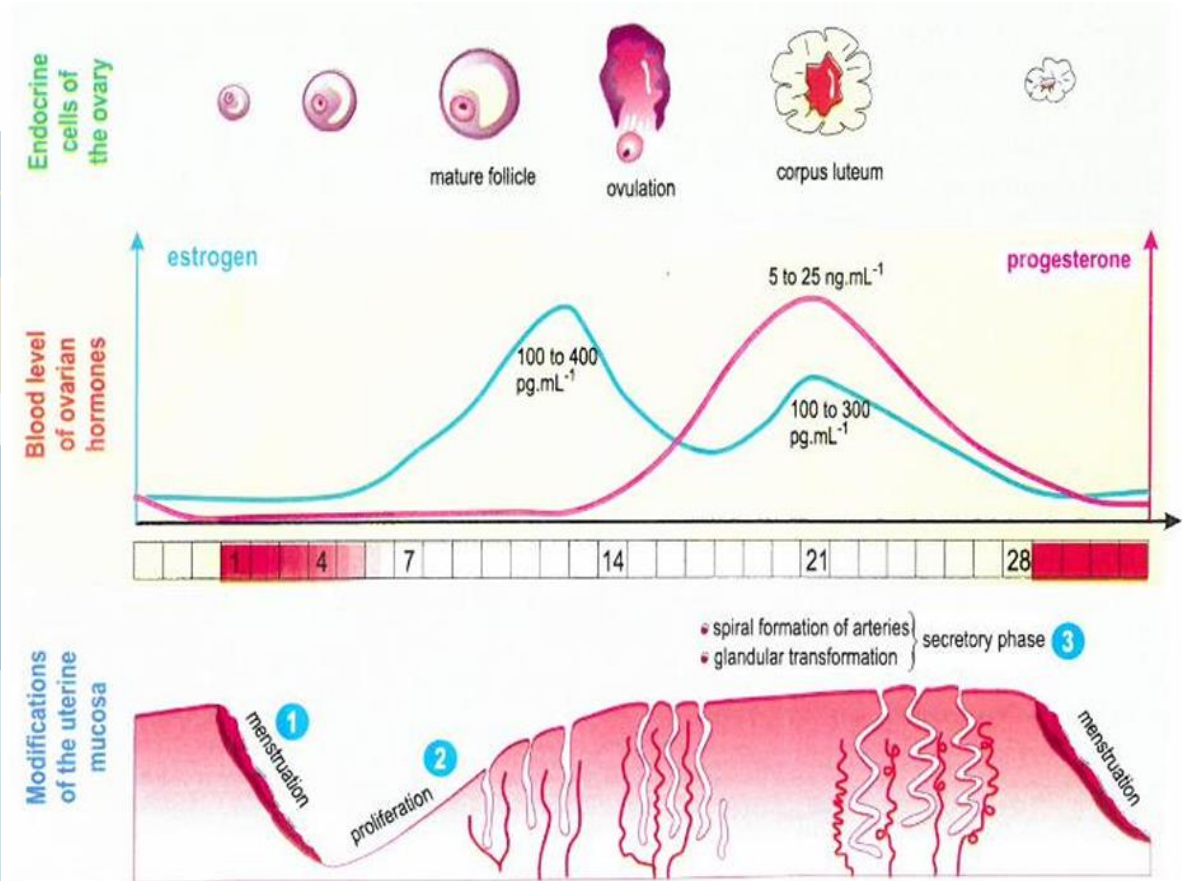
**Doc.d** Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.

During follicular phase (day 1 to day 13 of the cycle), the development of ovarian follicles causes an increase in estrogen level until it reaches its 1<sup>st</sup> peak around the day of ovulation where the follicles mature into a Graafian follicle. This estrogen release stimulates the proliferation (development) of the uterine mucosa (endometrium) and prepares the uterus for progesterone, (stimulates the synthesis of progesterone receptors).



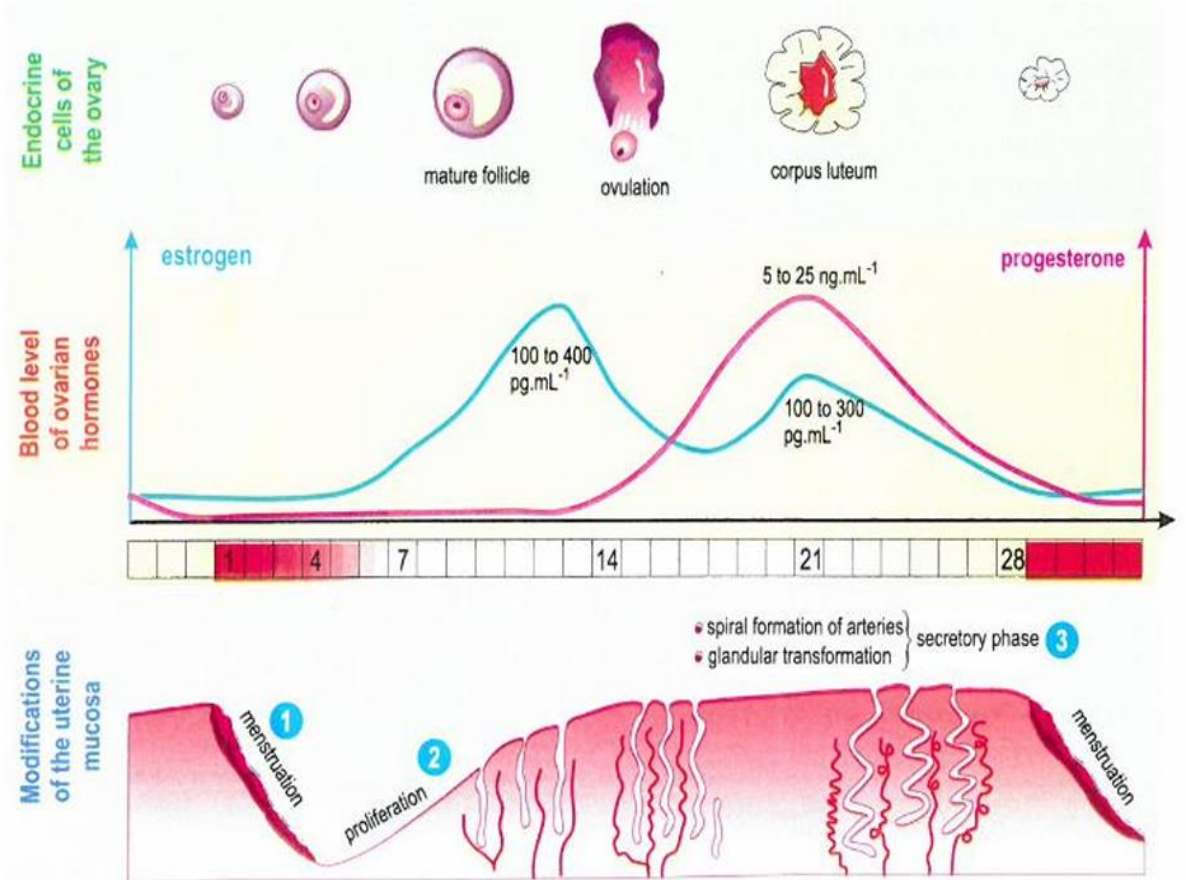
**Doc.d** Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.

*\*At day of ovulation (day 14), the rupture of the Graafian follicle causes a drop in the concentration of estrogen level.*



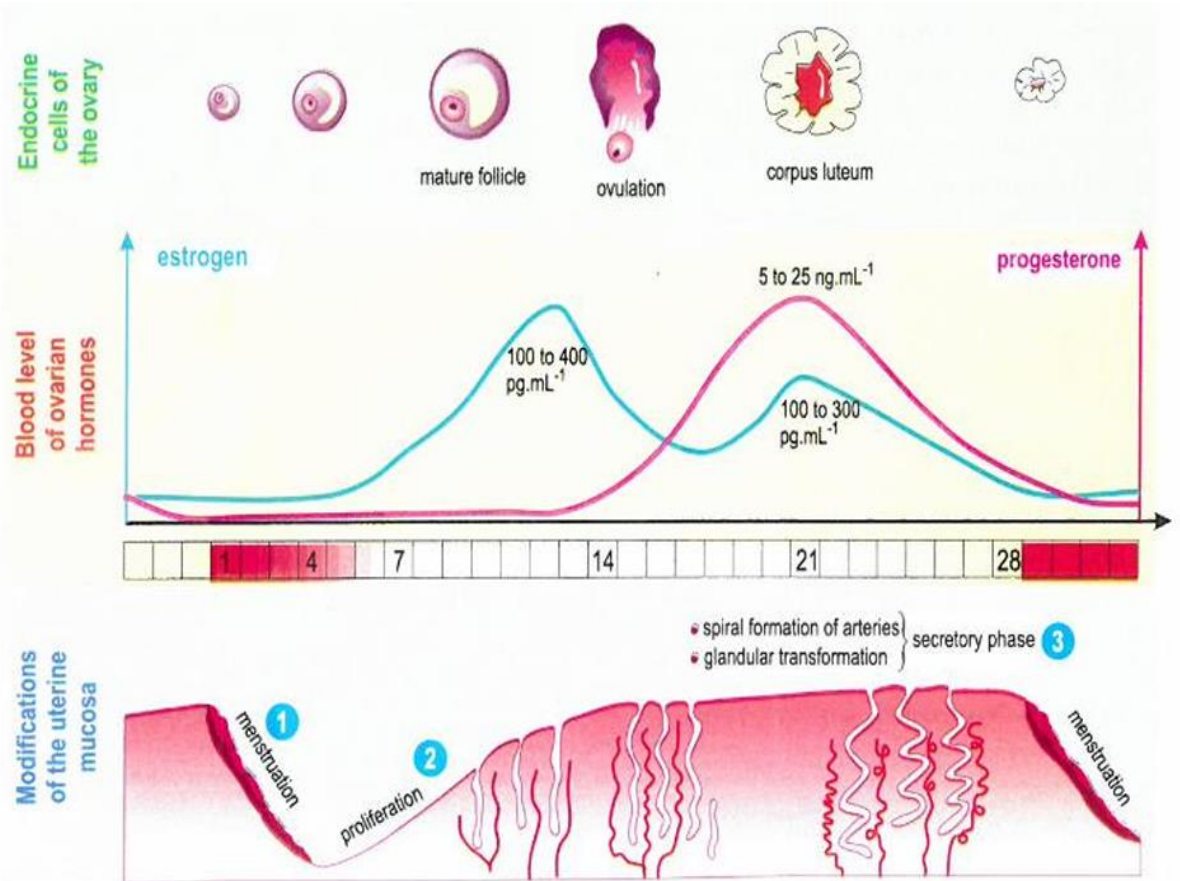
**Doc.d** Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.

- After the day of ovulation, during the luteal phase (day 14 to day 28), the ruptured follicle will develop into corpus luteum which secretes estrogen and progesterone that reach their peak on day 21 where there is maximum development of the corpus luteum. This increase in the hormones stimulates the formation of the uterine lining having well developed blood vessels and glands (secretory phase) in the endometrium.



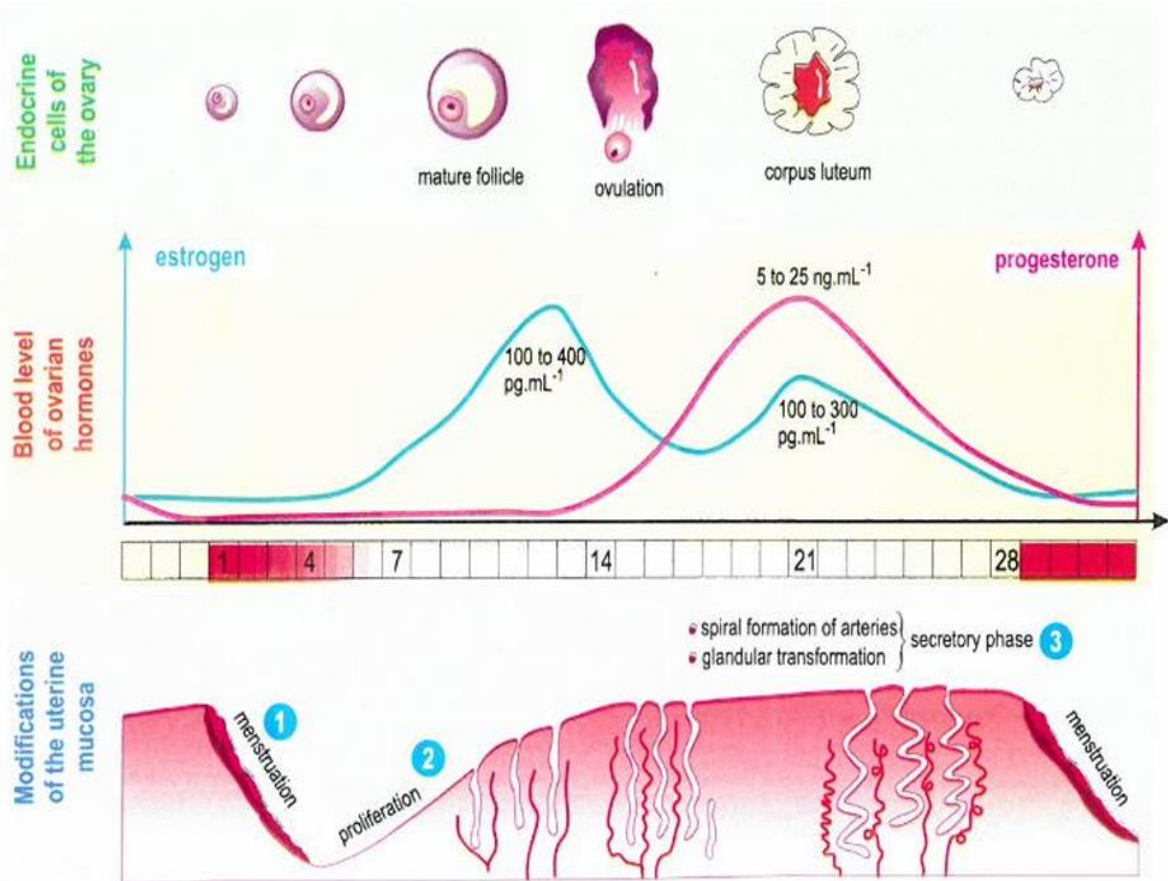
*Doc.d Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.*

- **If there is no pregnancy (no fertilization)**, the corpus luteum will degenerate into corpus albicans causing a drop in the level of estrogen and progesterone which leads to the sloughing off of the superficial layer of the endometrium causing menses or menstruation and a new cycle begins.



**Doc.d** Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.

***\*If there is fertilization, and implantation of the embryo occurs, the corpus luteum will persist (remain) for 3 months secreting estrogen and progesterone to support pregnancy and the uterine lining will remain (no sloughing off).***



**Doc.d** Cyclic evolution of an ovarian follicle, of the ovarian hormones, and of the uterine mucosa.