Chapter 15:

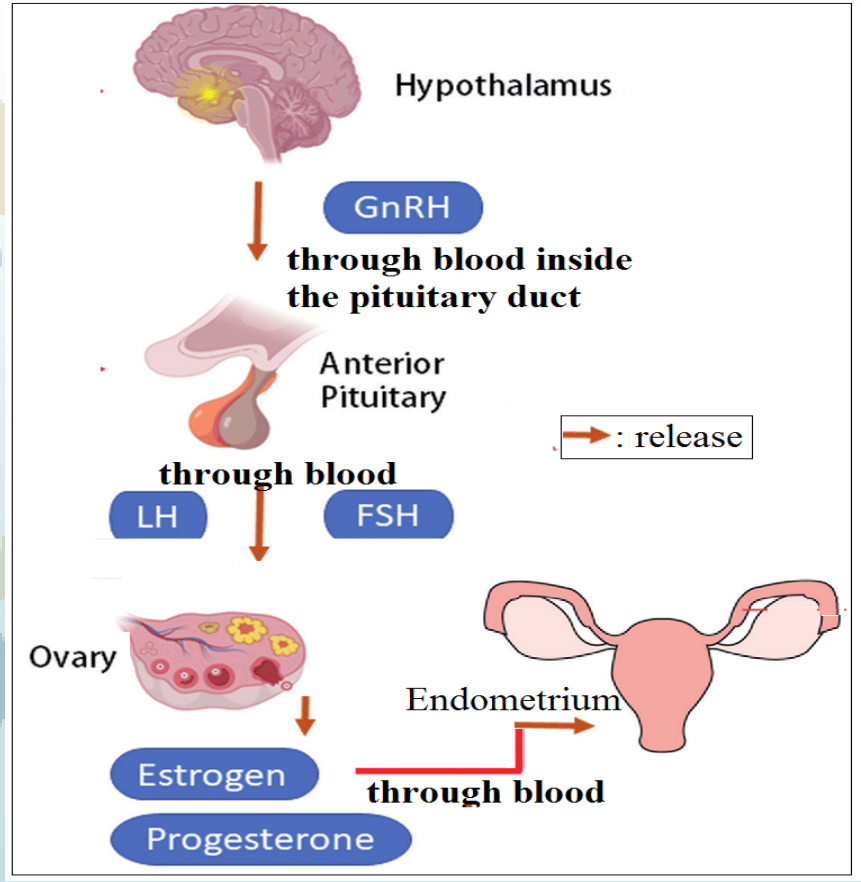
Regulation of the Female Sexual Hormones

- ***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 3: Hypothalamo-pituitary axis and Ovarian Hormones

I. The Hypothalamo-Pituitary Axis

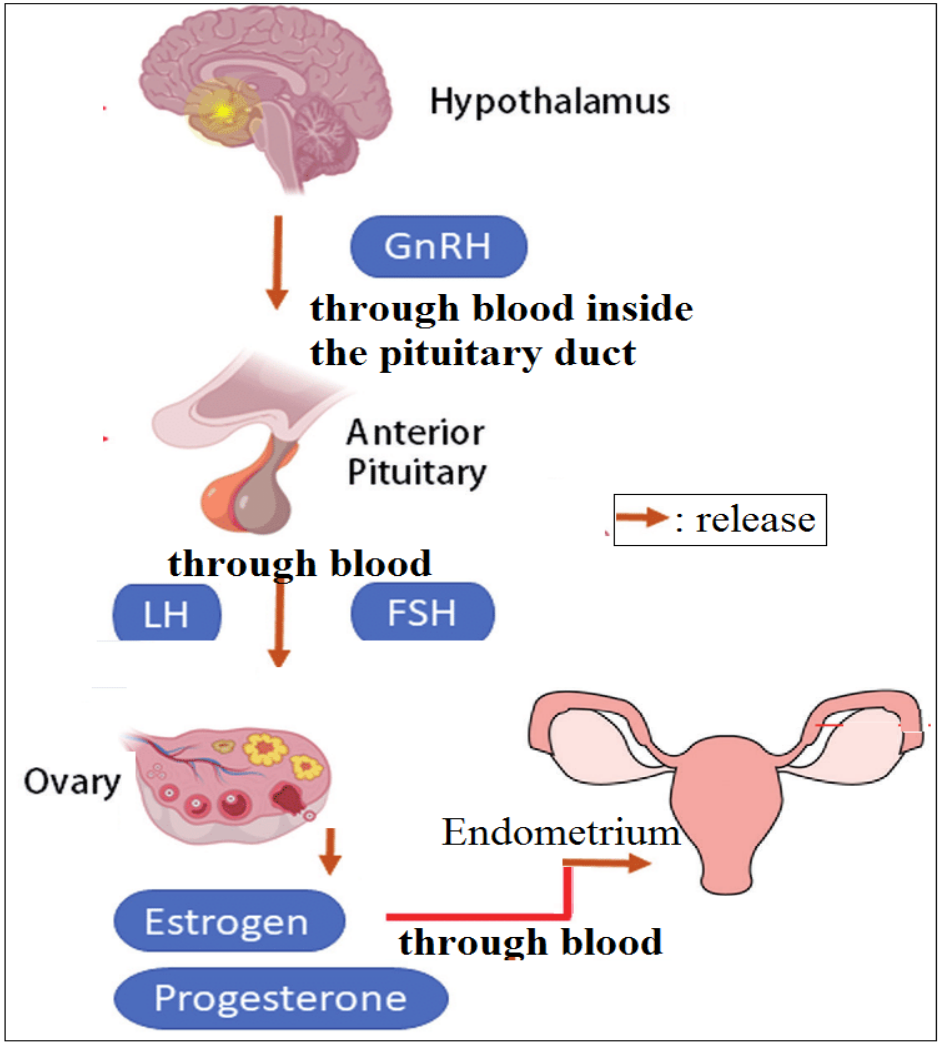
- The hypothalamo-pituitary axis includes the connection between the hypothalamus and the pituitary gland.
- **Hypothalamus:** is a group of nerve cells situated at the base of the brain that secretes a neuro hormone **GnRH**. This hormone travels to the pituitary gland through blood.



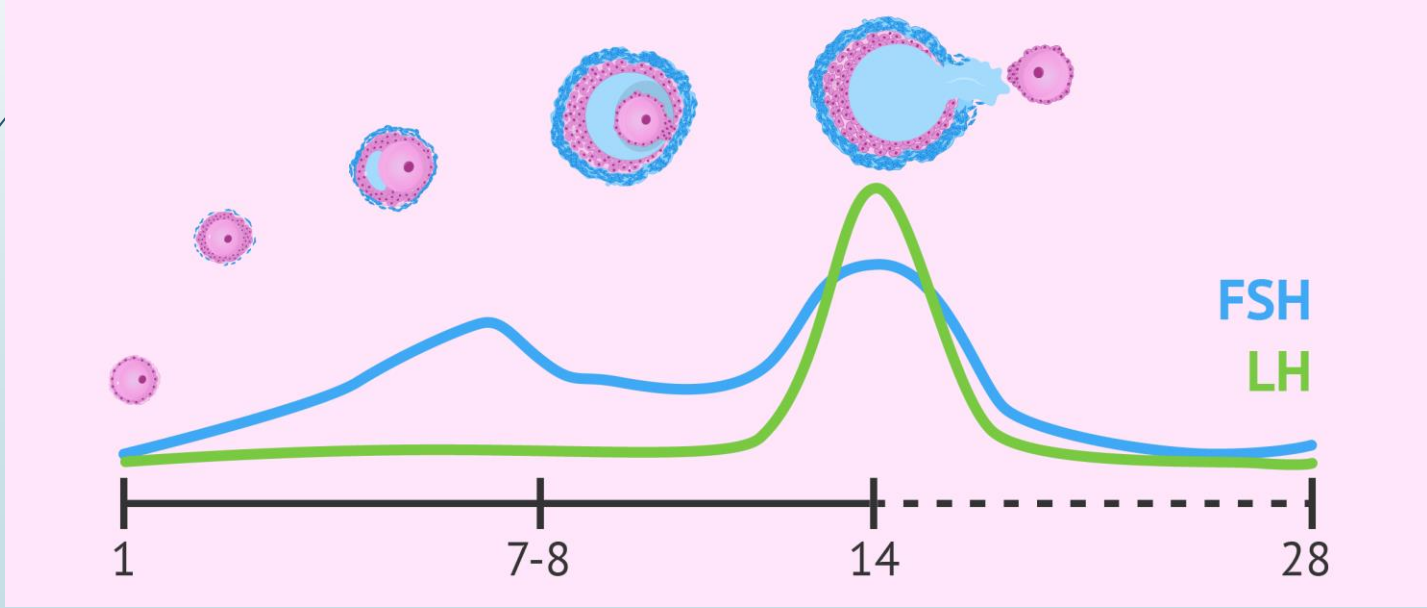
- **The pituitary gland** (physis) is a small gland connected to the hypothalamus through a hypo-physeal vascular duct. It consists of two parts: anterior pituitary gland and posterior pituitary gland.

- The anterior pituitary gland is an endocrine gland that secretes gonadotropic hormones (pituitary hormones) into blood:

  FSH and **LH**.



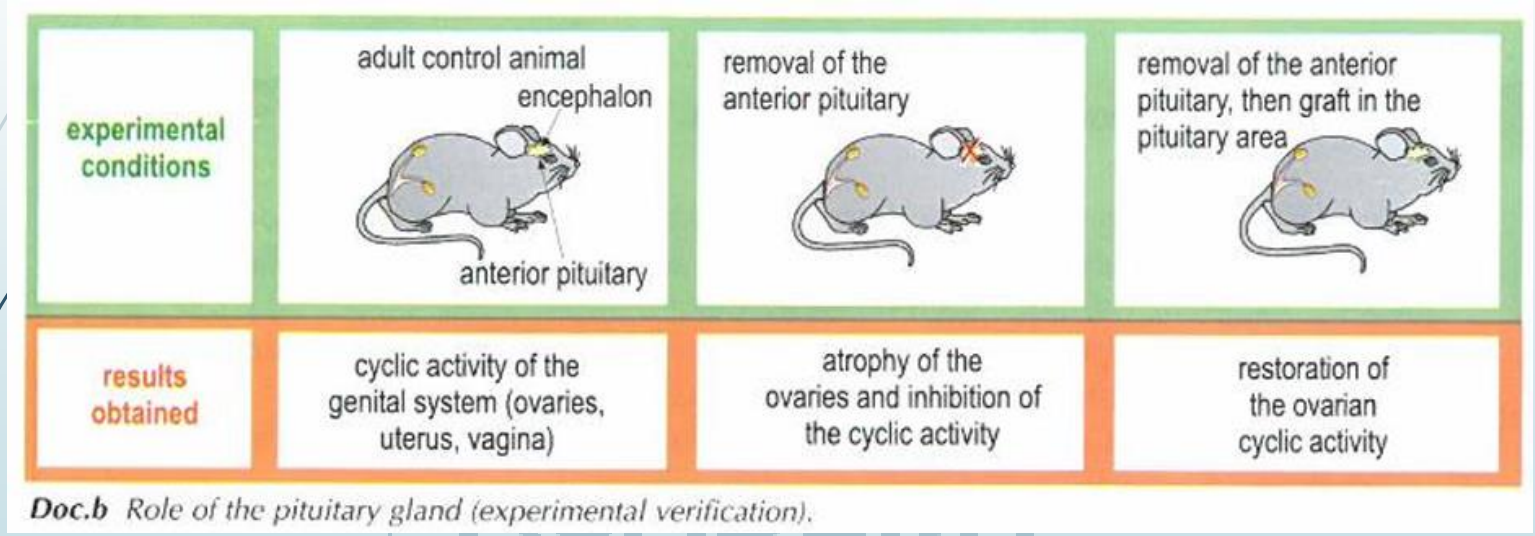
- **FSH: Follicular stimulating hormone**, it stimulates the development of the follicles in the ovaries to become a mature Graafian follicle.
- **LH: Luteinizing hormone**, it forms a peak around the day of ovulation that stimulates ovulation and the transformation of the ruptured follicle into corpus luteum.



II. Pituitary Control of the Ovarian Secretions:

-Application 1:

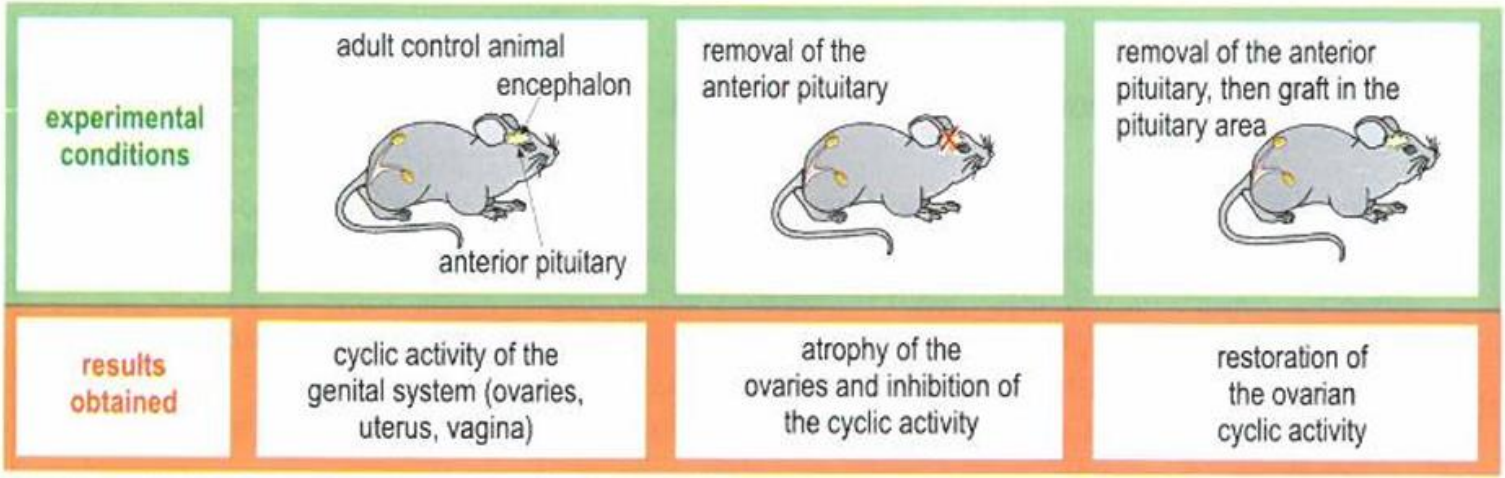
To verify the hormonal activities of the ovaries (not autonomous), the following experiment was performed, doc b.



Doc.b *Role of the pituitary gland (experimental verification).*

1- Formulate the tested hypothesis.

Hypothesis: The ovaries are not autonomous.

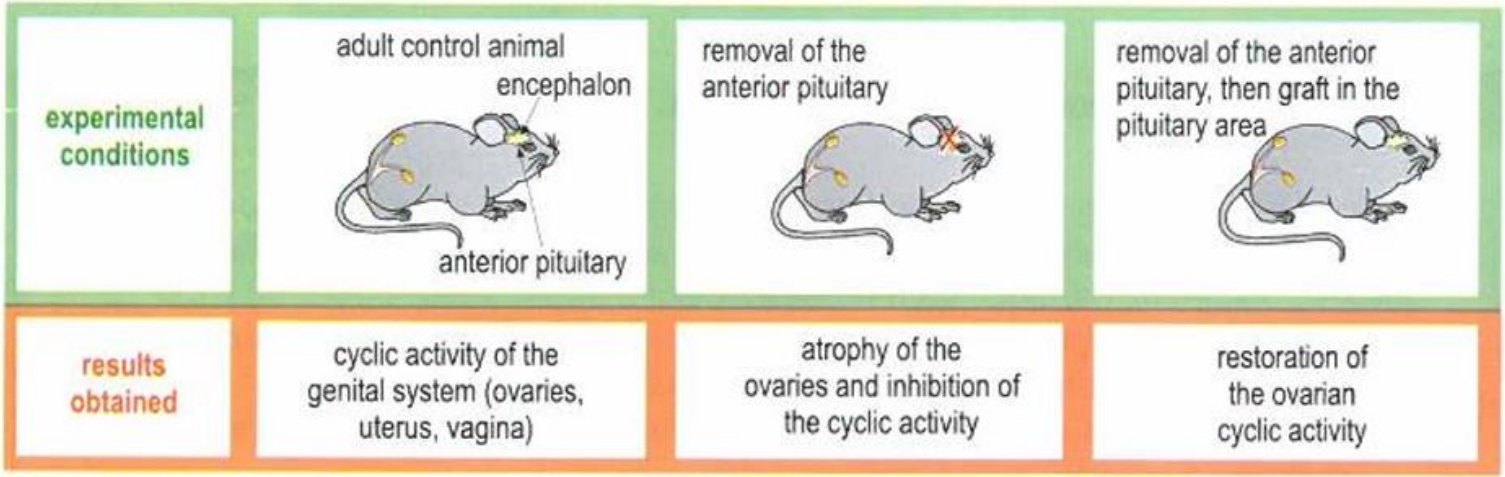


Doc.b *Role of the pituitary gland (experimental verification).*

2- Interpret the results of experiment 1 and 2.

In exp 1, in an adult control animal having encephalon and anterior pituitary gland, there is cyclic activity of the genital system (ovaries, uterus, vagina). While in exp 2, after removal of the anterior pituitary gland of the mouse, there is atrophy (degeneration) of the ovaries and inhibition of the cyclic activity.

This means that the anterior pituitary stimulates the cyclic activity of the ovaries and the genital system.

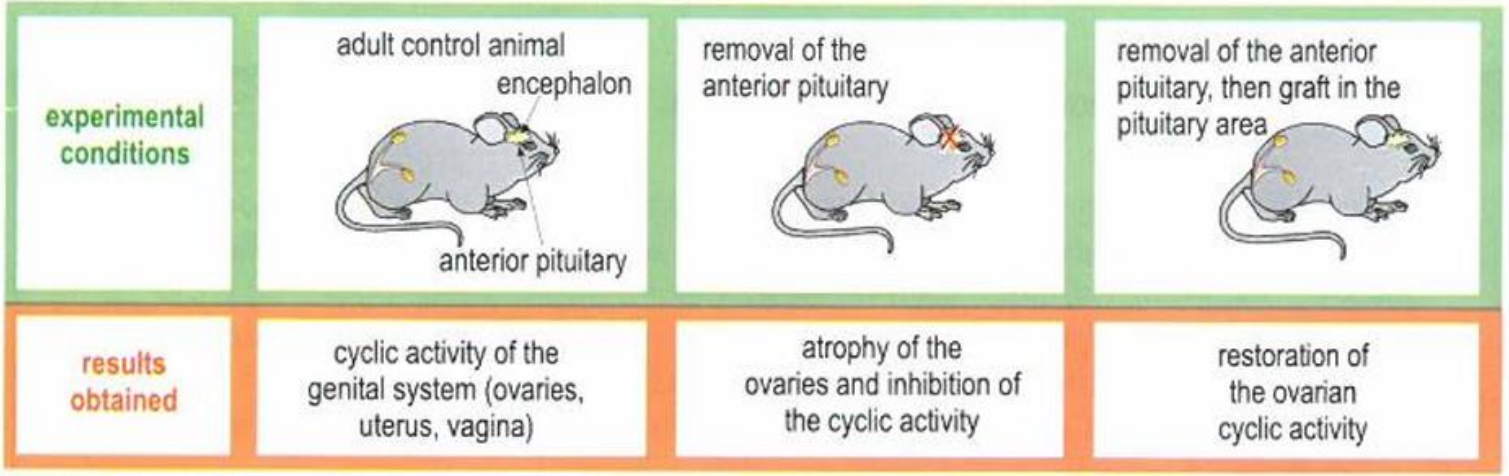


Doc.b *Role of the pituitary gland (experimental verification).*

3- Interpret the results of experiment 3.

In exp 3, upon the removal of the anterior pituitary, then graft in the pituitary area, there is restoration of the ovarian cyclic activity.

This means that the anterior pituitary stimulates (controls) the ovaries through blood and it is active only in the local pituitary area.



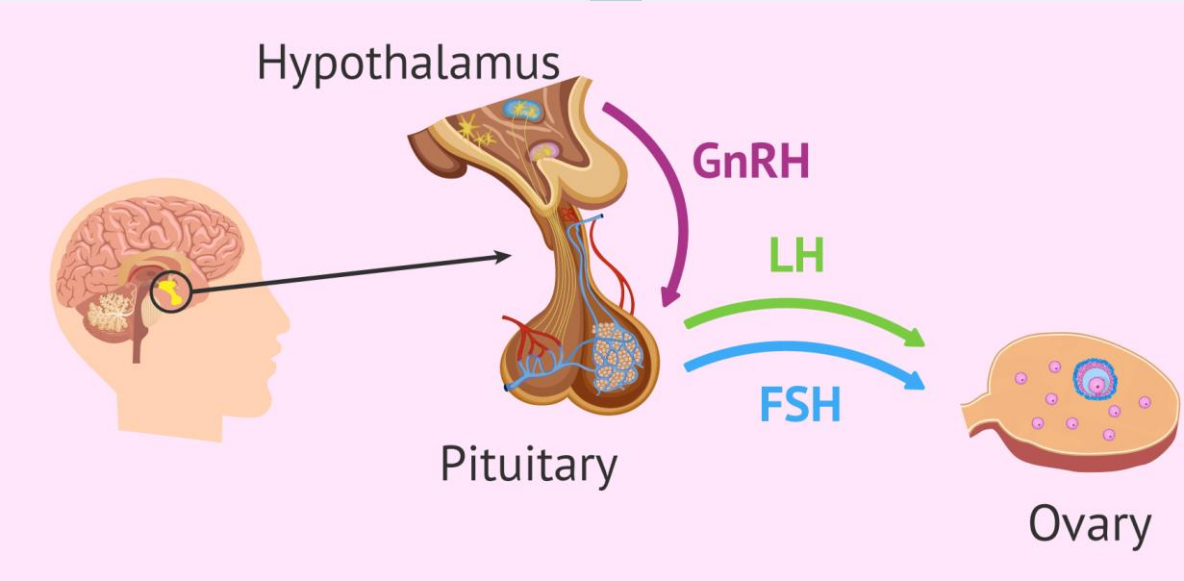
Doc.b *Role of the pituitary gland (experimental verification).*

4- Formulate a hypothesis explaining the graft in the area of the pituitary.

Hypothesis: GnRH acts only at a short distance.

***GnRH (Gonadotropin releasing hormone) released by the hypothalamus that stimulates the anterior pituitary is a fragile hormone, so it can't move in blood for long distances, it will be destroyed. That's why we can't graft the pituitary gland far from the hypothalamus but in the pituitary area.**

-Role of GnRH: Stimulate the secretion of FSH and LH by the anterior pituitary gland.



- Why is GnRH considered as neurohormone?

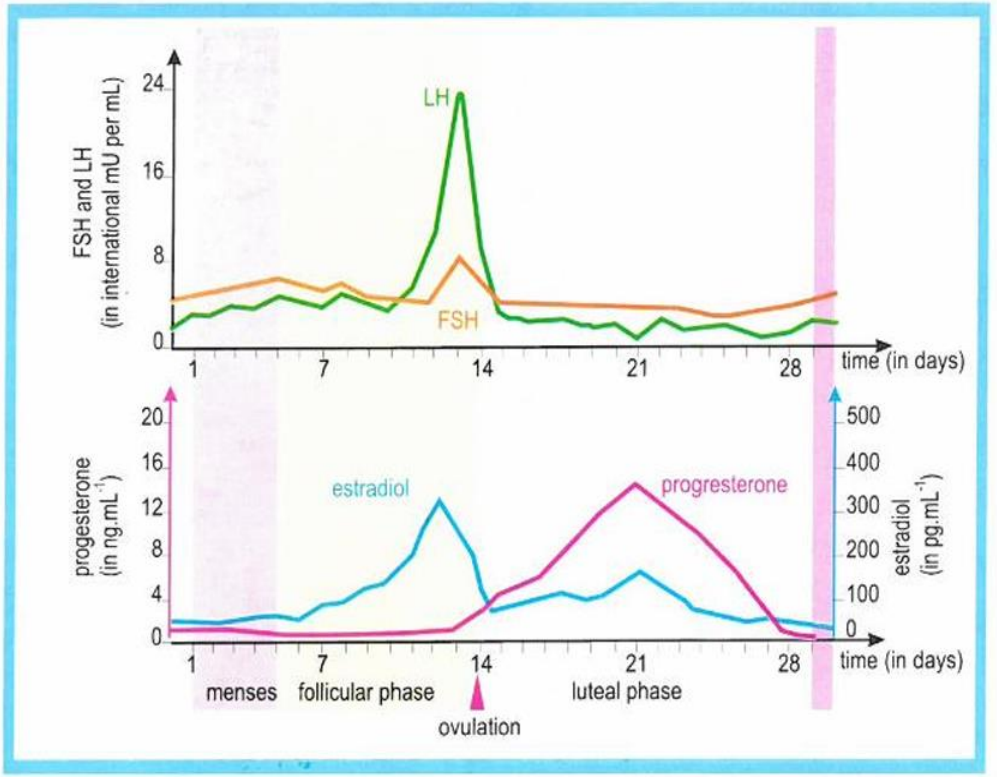
Because GnRH is secreted by neurons (neuro) and it is carried through blood (hormone) that’s why it is considered as neurohormone.

-Application 2:

- **Document c shows the evolution of the plasma level of the pituitary and of the ovarian hormones.**

1- Indicate the relation existing between the pituitary secretions and the ovarian activity.

The variation in the pituitary and ovarian hormones is synchronized.

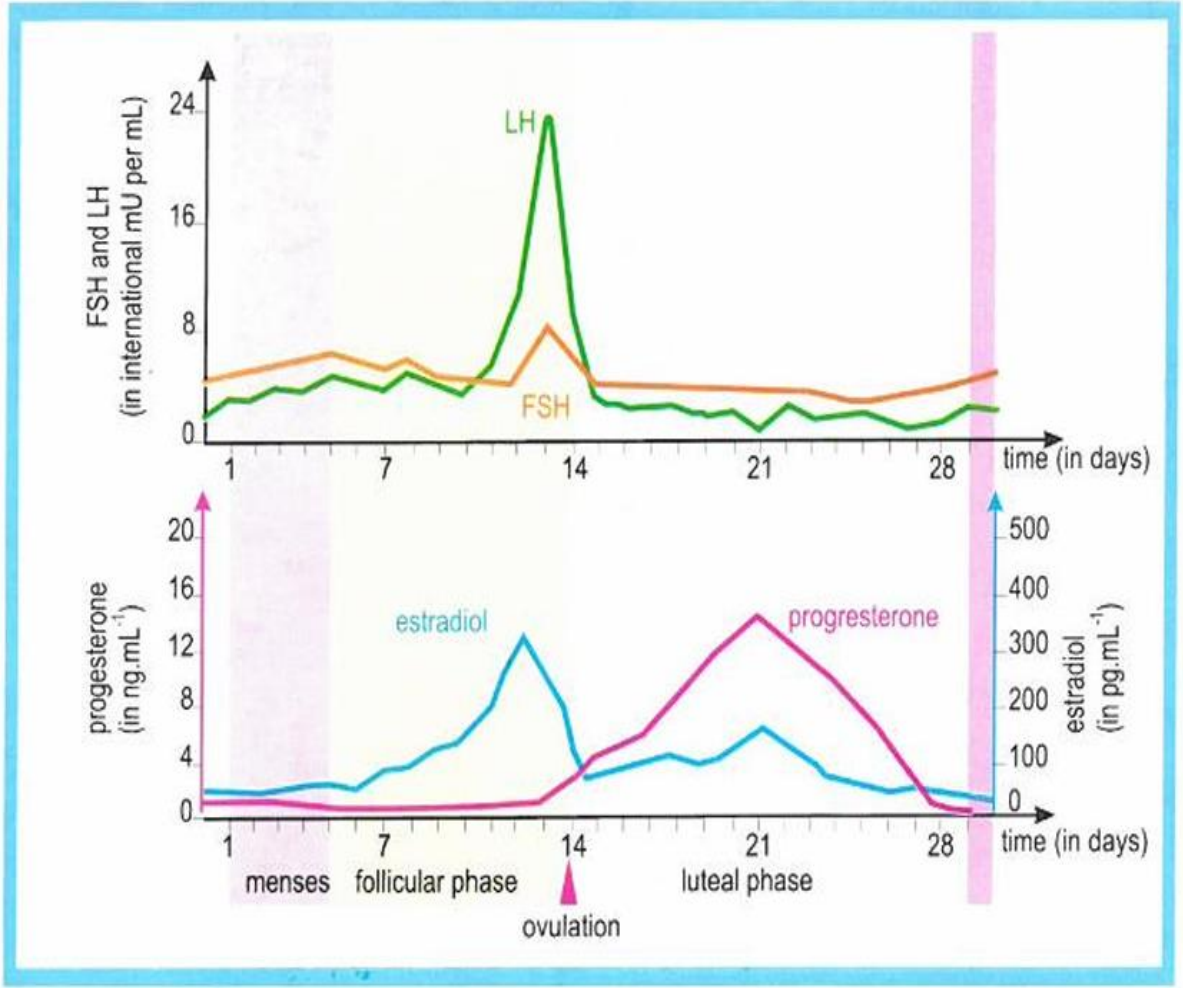


Doc.c *Synchronized evolution of the plasma level of the pituitary and of the ovarian hormones.*

2- What can you draw out regarding the peaks of pituitary hormones?

The peaks of FSH and LH before ovulation are necessary to cause ovulation.

Doc.c belongs to a fertile non-pregnant woman.



Doc.c *Synchronized evolution of the plasma level of the pituitary and of the ovarian hormones.*

III. Hypothalamic Control of the Pituitary Secretions:

- Application 3:

The following experiments were carried out to show that the secretion of pituitary hormones is, just like the secretion of ovarian hormones, not autonomous.

First series of experiments

Experiments	Results
Destruction of some hypothalamic neurons	The anterior pituitary gland stops secreting LH and FSH
Electric stimulation of these neurons	The secretion of LH and FSH by the pituitary gland increases abruptly
Disconnection of the pituitary gland from the hypothalamus	The anterior pituitary gland stops secreting LH and FSH
Taking a blood sample from the vascular network of the pituitary stem	A highly active substance, GnRH, may be isolated, stimulating therefore the release of gonadotropic hormones

Doc.d *Hypothalamic control: experimantal verification.*

1. Pick out the aim of the experiment.

To show that the secretion of pituitary hormones is not autonomous.

2- Interpret the results of experiments 1 and 2.

Upon destruction of some hypothalamic neurons, the anterior pituitary gland stops secreting LH and FSH. While, upon electric stimulation of these neurons, the secretion of LH and FSH by the pituitary gland increases abruptly.

This implies that the hypothalamus stimulates the secretion of LH and FSH by the anterior pituitary gland.

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4- Analyze experiment 3. What do you conclude?

After disconnection of the pituitary gland from the hypothalamus, the anterior pituitary gland stops secreting LH and FSH.

Therefore, the release of LH and FSH is ensured by a connection between the hypothalamus and the anterior pituitary gland.

5- Draw out a conclusion referring to experiment 4.

Therefore, GnRH is a hypothalamic hormone which stimulates the release FSH and LH by the pituitary gland through blood.

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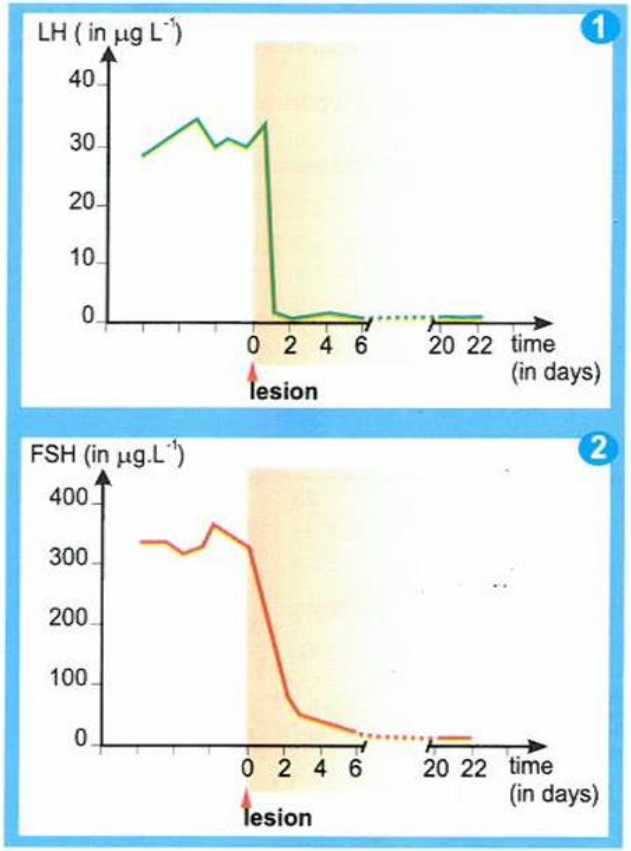
- Application 4:

- **Document e shows the effect of a hypothalamic lesion on the level of LH and FSH.**

Second series of experiments

- In a female monkey, we carry on a selective lesion in the posterior part of the hypothalamus *(Doc.e)*.
- In another female monkey subjected to a similar lesion, we inject GnRH, in a discontinuous or a continuous manner.

In both experiments, the evolution of FSH and LH secretion is illustrated by the curves in ***doc.e*** and ***f***.



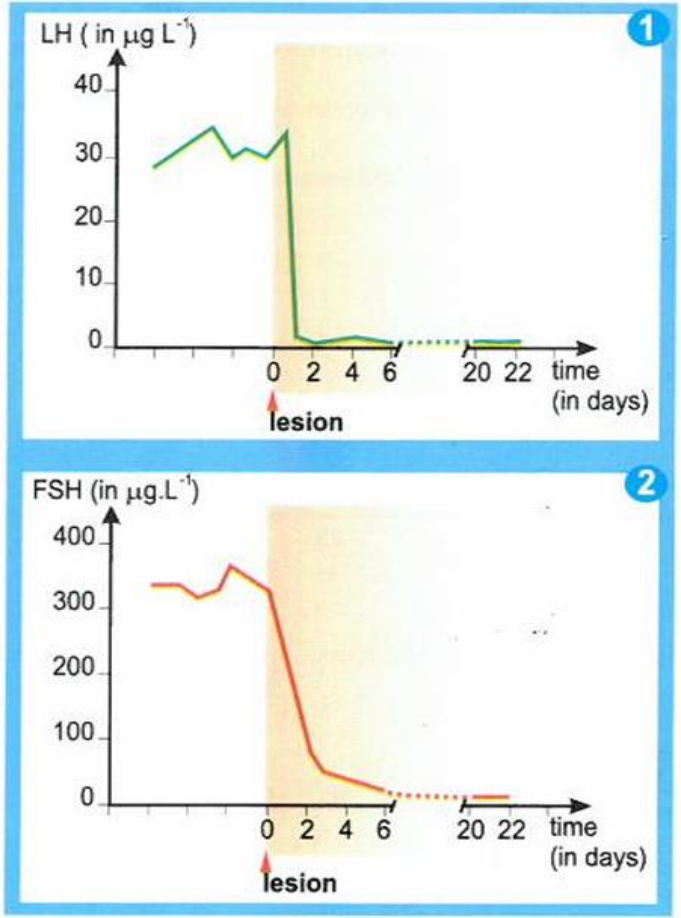
Doc.e *Effects of a hypothalamic lesion on the level of LH and FSH.*

1- Interpret the results.

Before the lesion of the posterior part of the hypothalamus, LH fluctuates between 28 ug.l^{-1} and 35 ug.l^{-1}. However, after the lesion, LH **decreases** sharply to null after 2 days and remains **constant** as time increases to 22 days.

Same for FSH…

This means that the hypothalamus (posterior part) stimulates the pituitary secretion of FSH and LH.



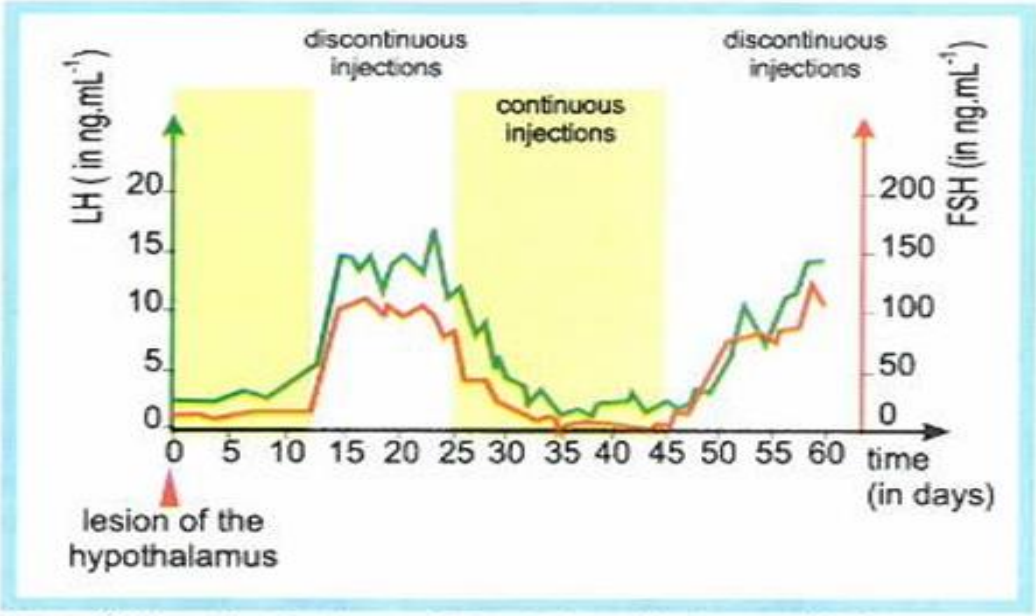
Doc.e *Effects of a hypothalamic lesion on the level of LH and FSH.*

- Application 5:

- **Document f shows the level of LH and FSH after the hypothalamic lesion and GnRH injection.**

1- Draw out a conclusion.

Therefore, the hypothalamus releases GnRH in a **discontinuous (pulsatile)** manner to stimulate the release of pituitary hormones FSH and LH.



Doc.f *Level of LH and FSH after the hypothalamic lesion and GnRH injection.*

The Hypothalamo-Pituitary Axis