

# The HPG Axis

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**Training Course in Reproductive Health Research – Geneva 2008**



# Hormones are messengers

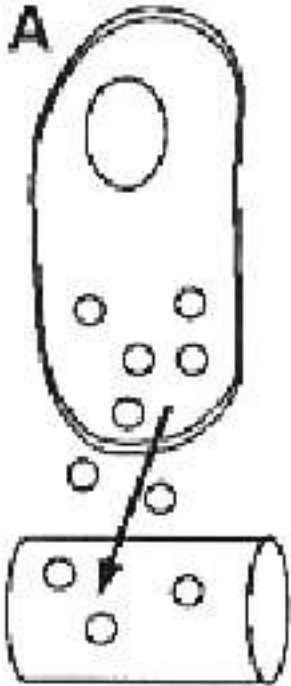
## Hormone:

Chemical signal secreted into the circulation and modulating the function of distant organs.

Particular exemple of a more generalized biological process

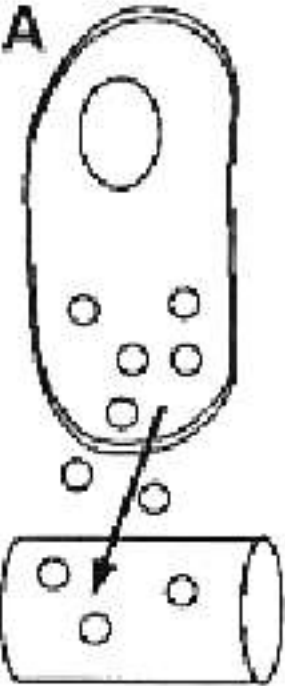
## Inter-cellular signalling

# Different types of hormonal interactions

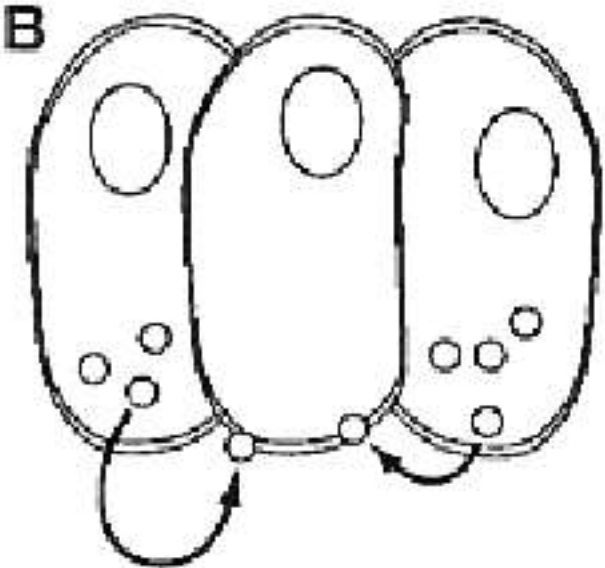


**Endocrine**

# Different types of hormonal interactions

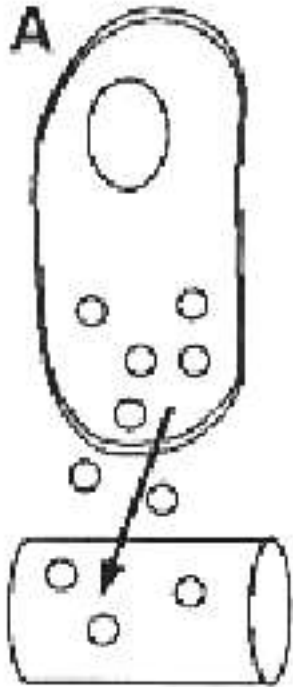


**Endocrine**

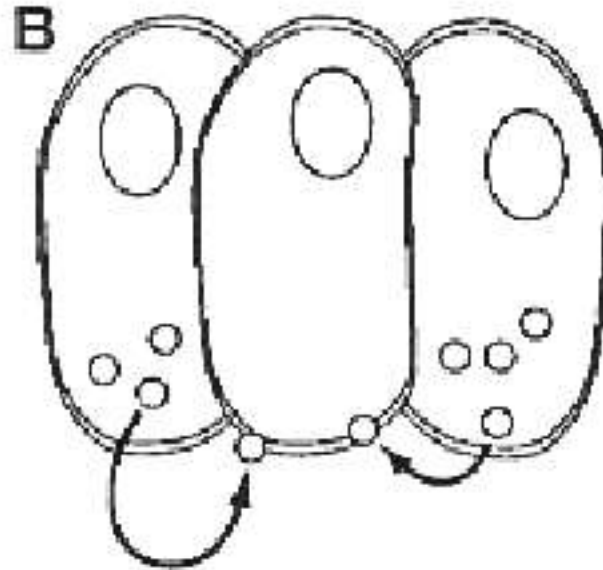


**Paracrine**

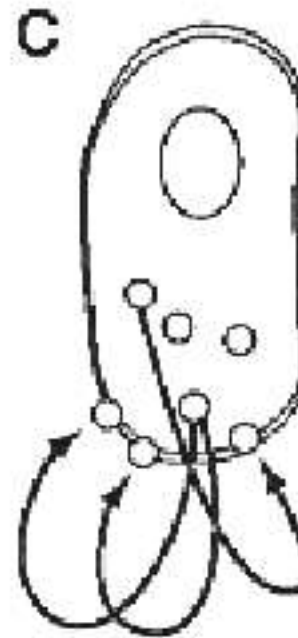
# Different types of hormonal interactions



**Endocrine**

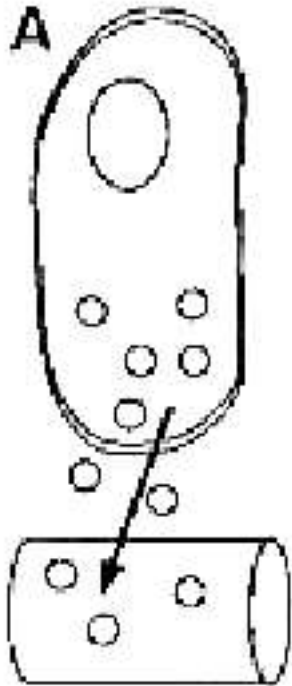


**Paracrine**

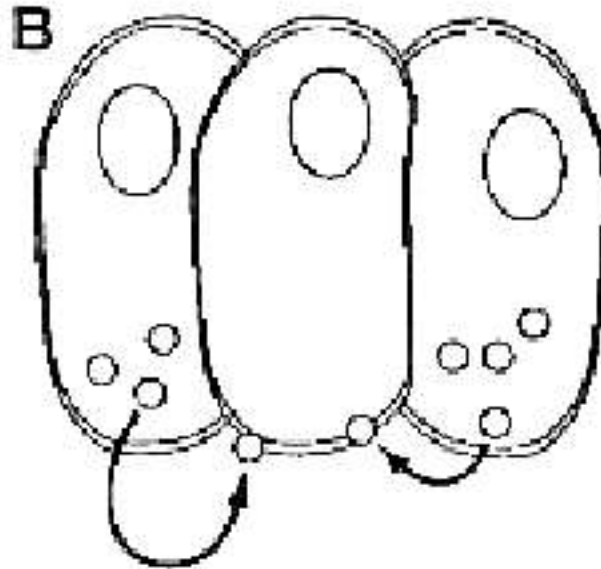


**Autocrine**

# Different types of hormonal interactions



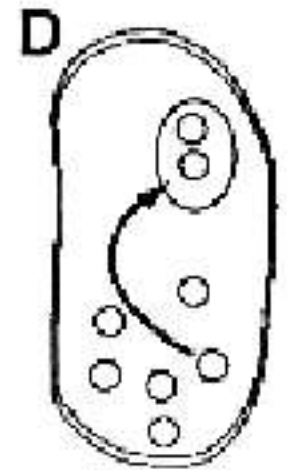
**Endocrine**



**Paracrine**

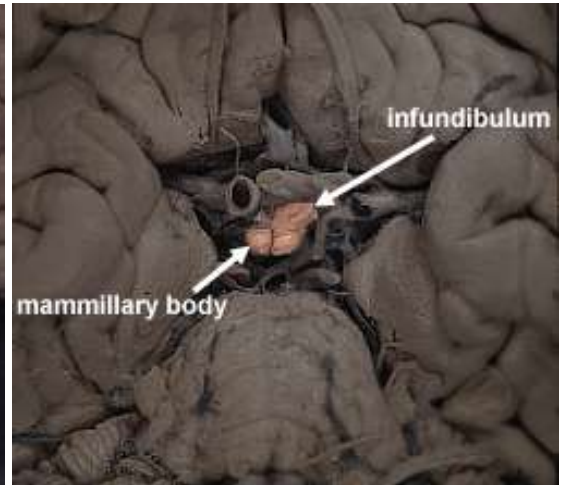
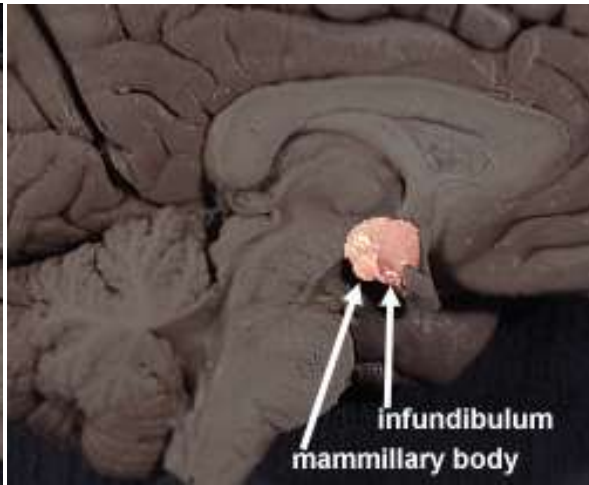
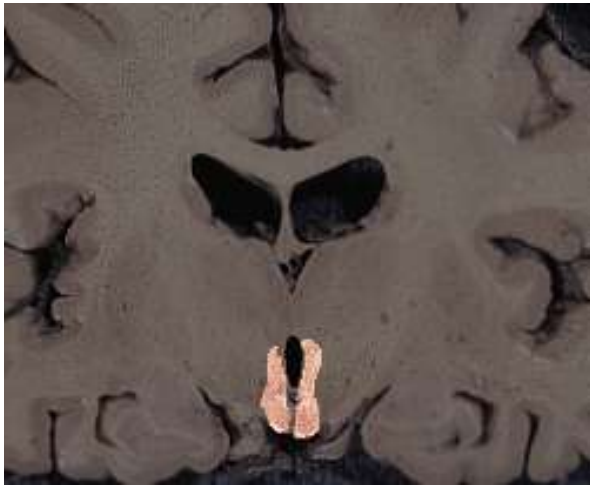


**Autocrine**



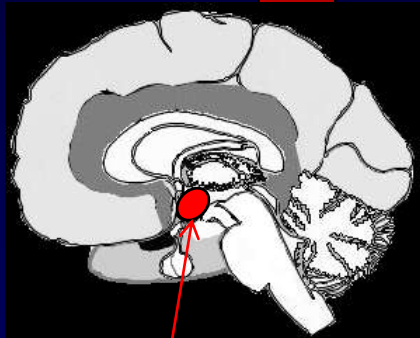
**Intracrine**

# **Functional anatomy of hypothalamo-pituitary unit**

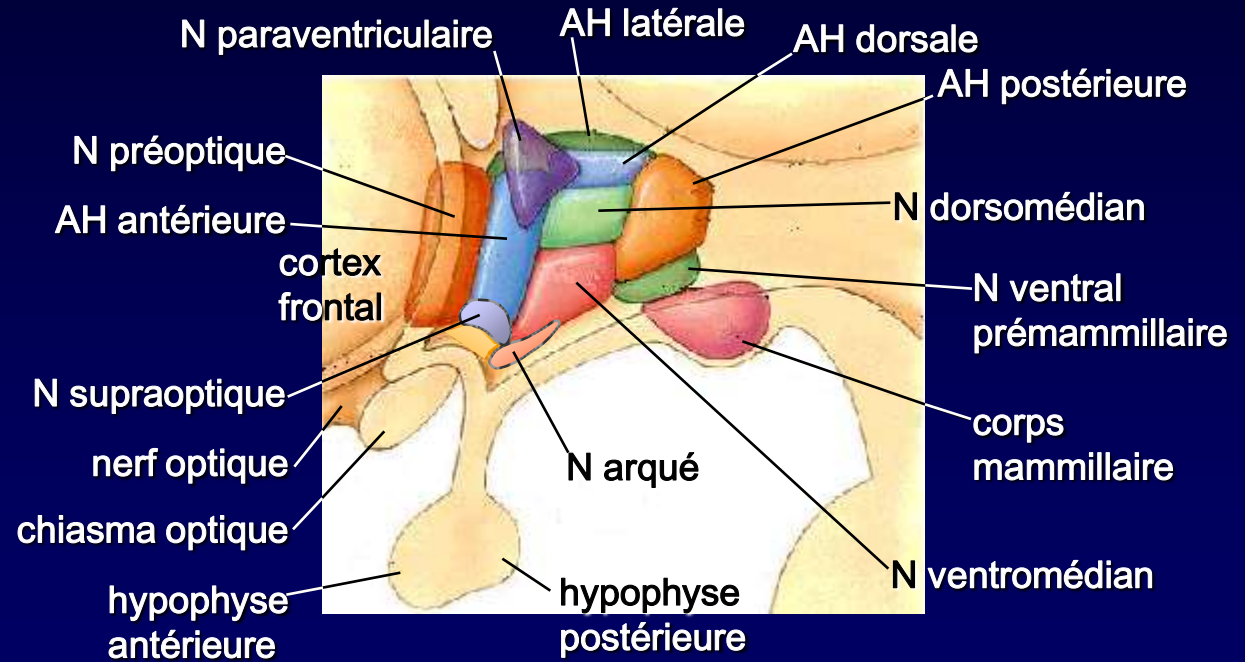
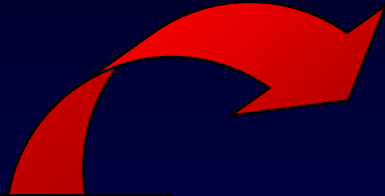




# The Hypothalamus



hypothalamus



# The Hypothalamus

## Structure

Different groups of neurones (nuclei) located in the walls of the inferior part of the third ventricle

## Fonction

Crossroad where numerous humoral signals are meeting and integrated, resulting in **metabolic and neuroendocrine** regulations.

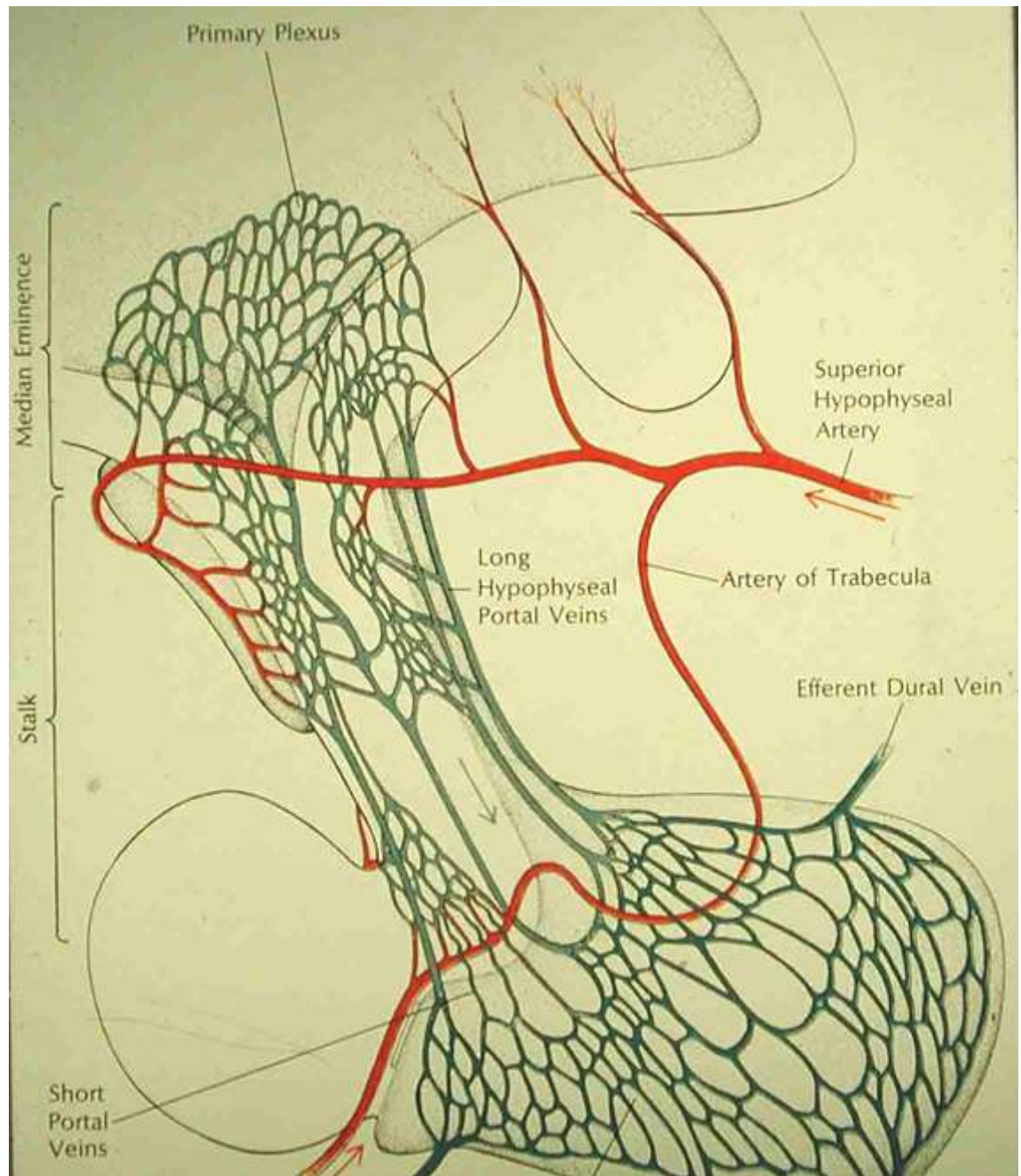
# The Hypothalamus

## Specific functions

- 1) Control of anterior pituitary, via *neurohormones* (releasing factors)
- 2) Synthesis of hormones to be stocked in posterior pituitary (then secreted into the peripheral circulation)
- 3) Modulation of food intake, metabolism and energy expenditure



# The hypothalamo-hypophysial portal blood vessels system



## **Anterior pituitary (adeno-hypophysis):**

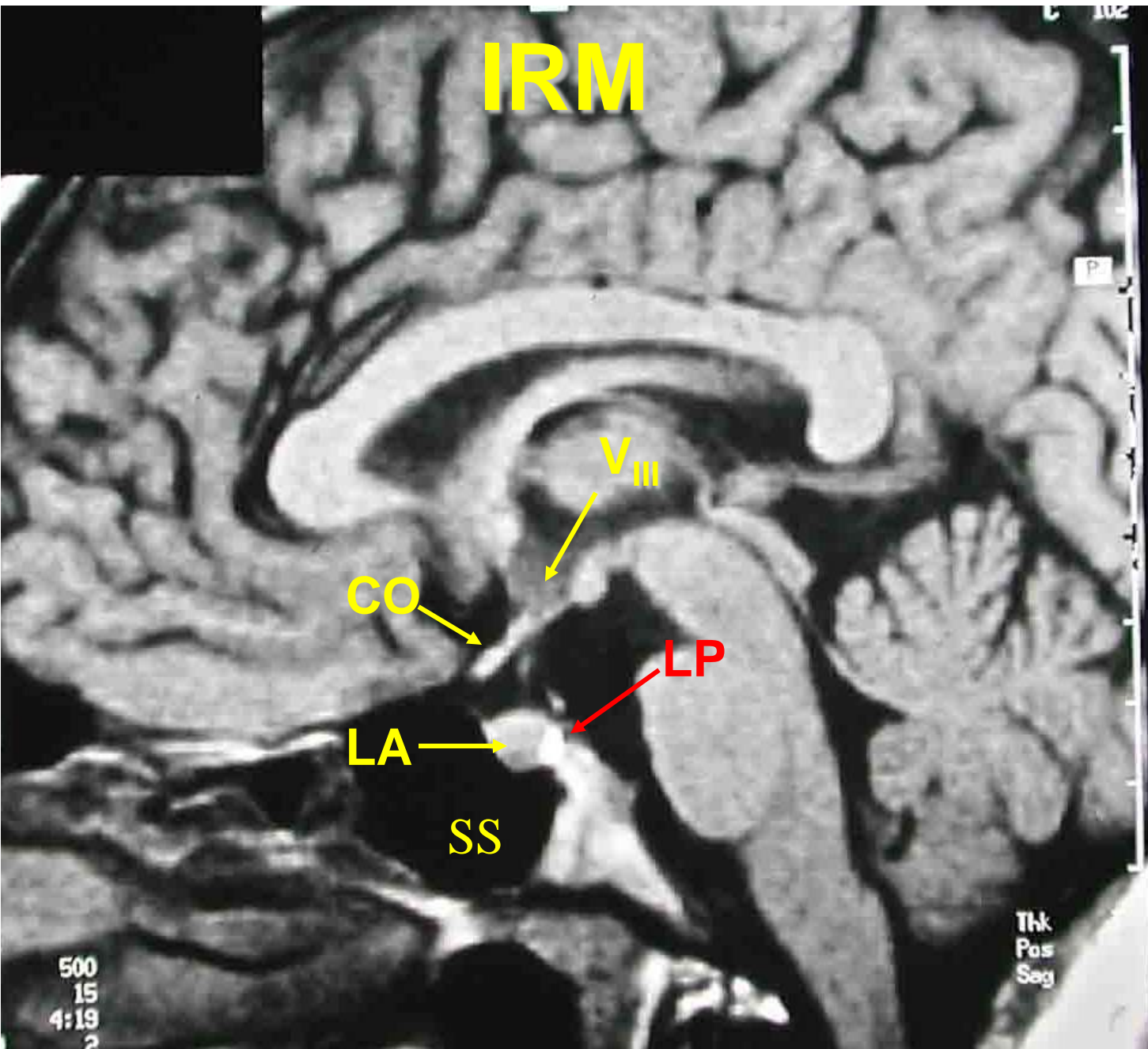
No nervous connection

## **Posterior hypophysis (neuro-hypophysis):**

Connected to the hypothalamus (nervous connections)



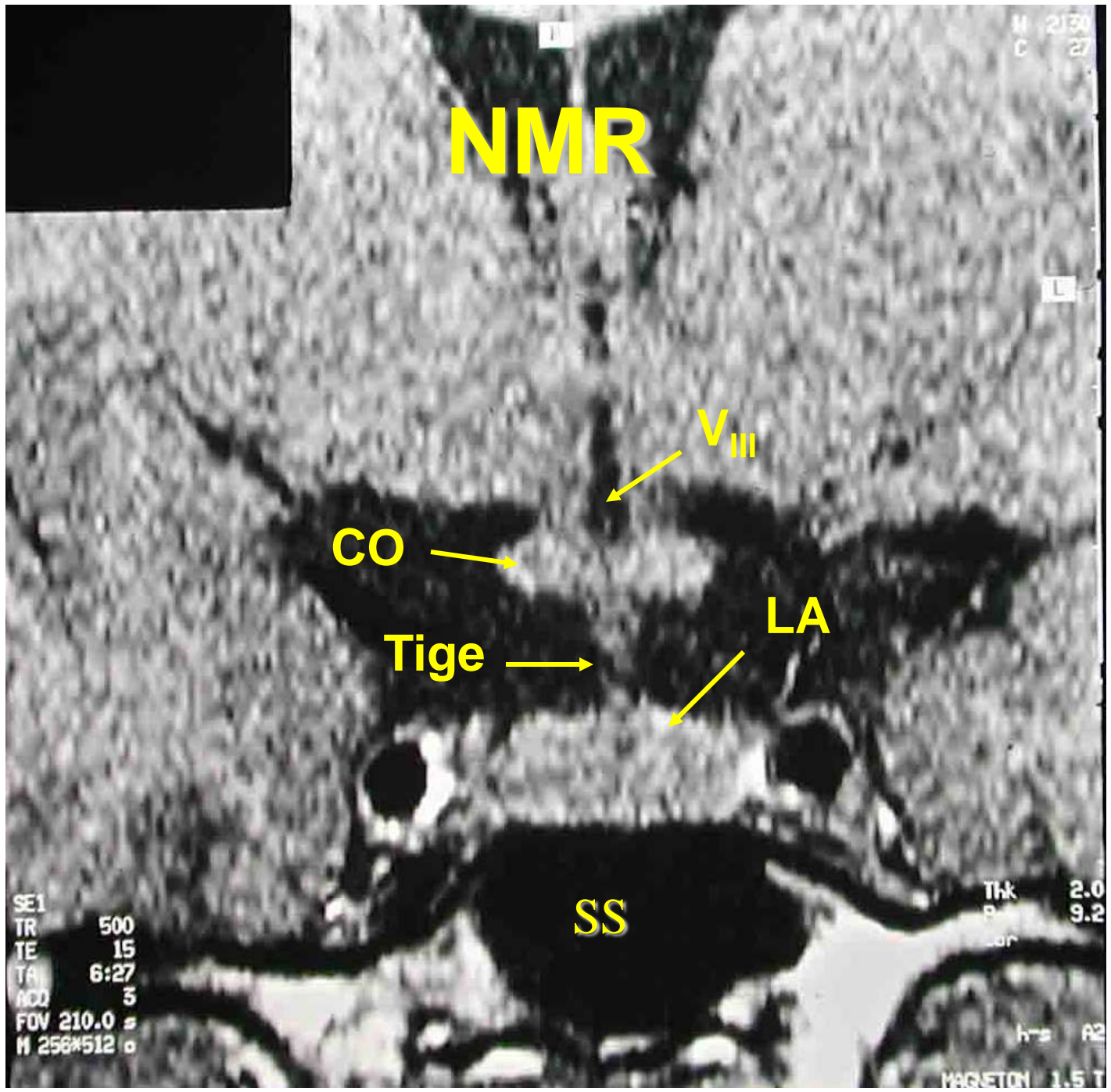
# IRM



500  
15  
4:19  
2

Thk  
Pos  
Sag

# NMR



SE1  
TR 500  
TE 15  
TA 6:27  
ACD 3  
FOV 210.0 s  
M 256\*512 o

Thk 2.0  
P 9.2  
Cor  
h-s A2  
MAGNETOM 1.5 T



# NMR, contrast

Limit of BBB

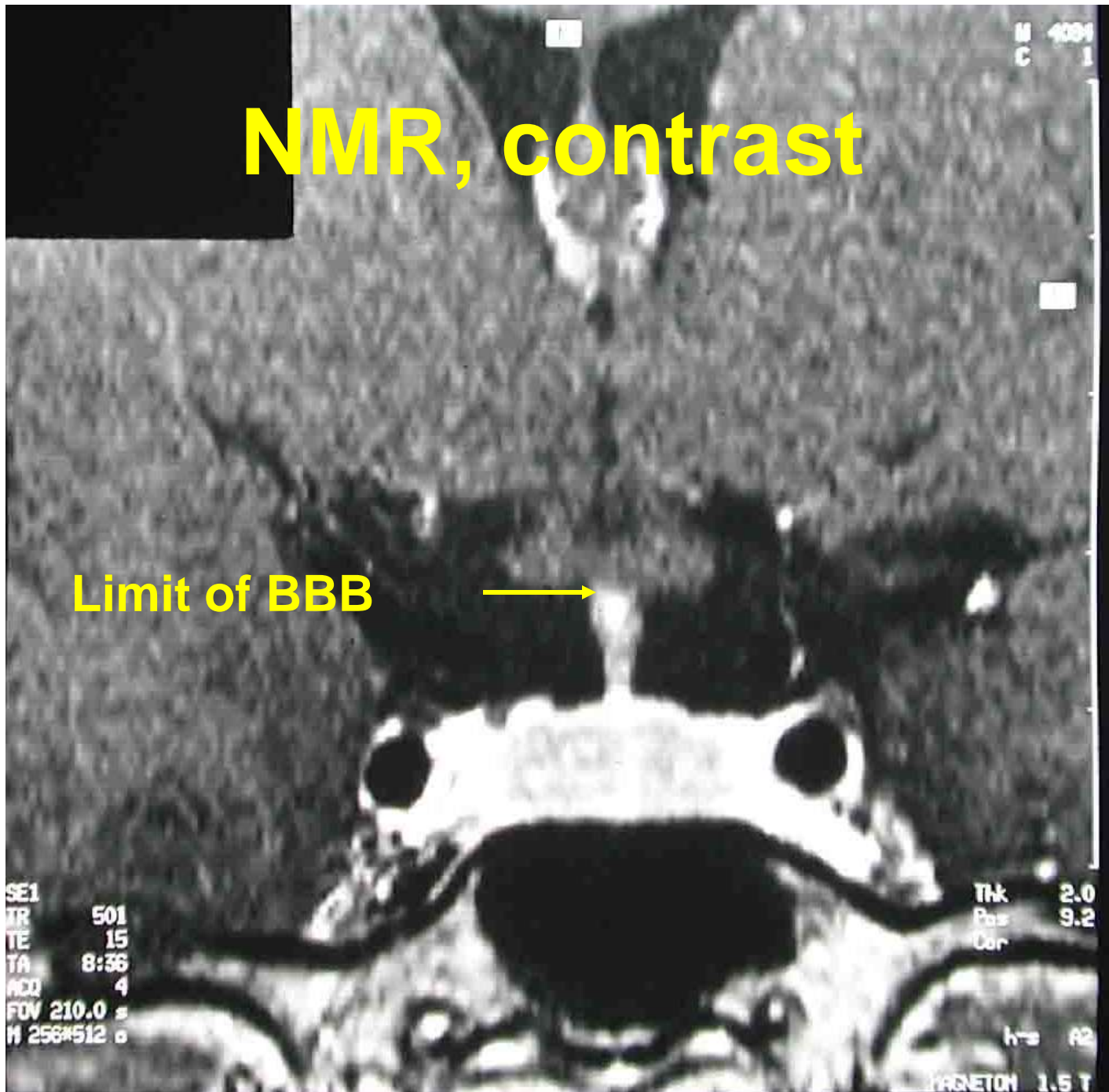


SE1  
TR 501  
TE 15  
TA 8:36  
ACQ 4  
FOV 210.0 s  
M 256\*512 o

Thk 2.0  
Pos 9.2  
Cor

h's A2

MAGNETOM 1.5 T



# The hypothalamus

## Specific functions

- 1) **Control of anterior pituitary, via neuro-hormones (releasing factors)**
- 2) Synthesis of hormones to be stocked in posterior pituitary (then secreted into the peripheral circulation)
- 3) Modulation of food intake, metabolism and energy expenditure

# The hypothalamo-hypophyseal hormonal axes

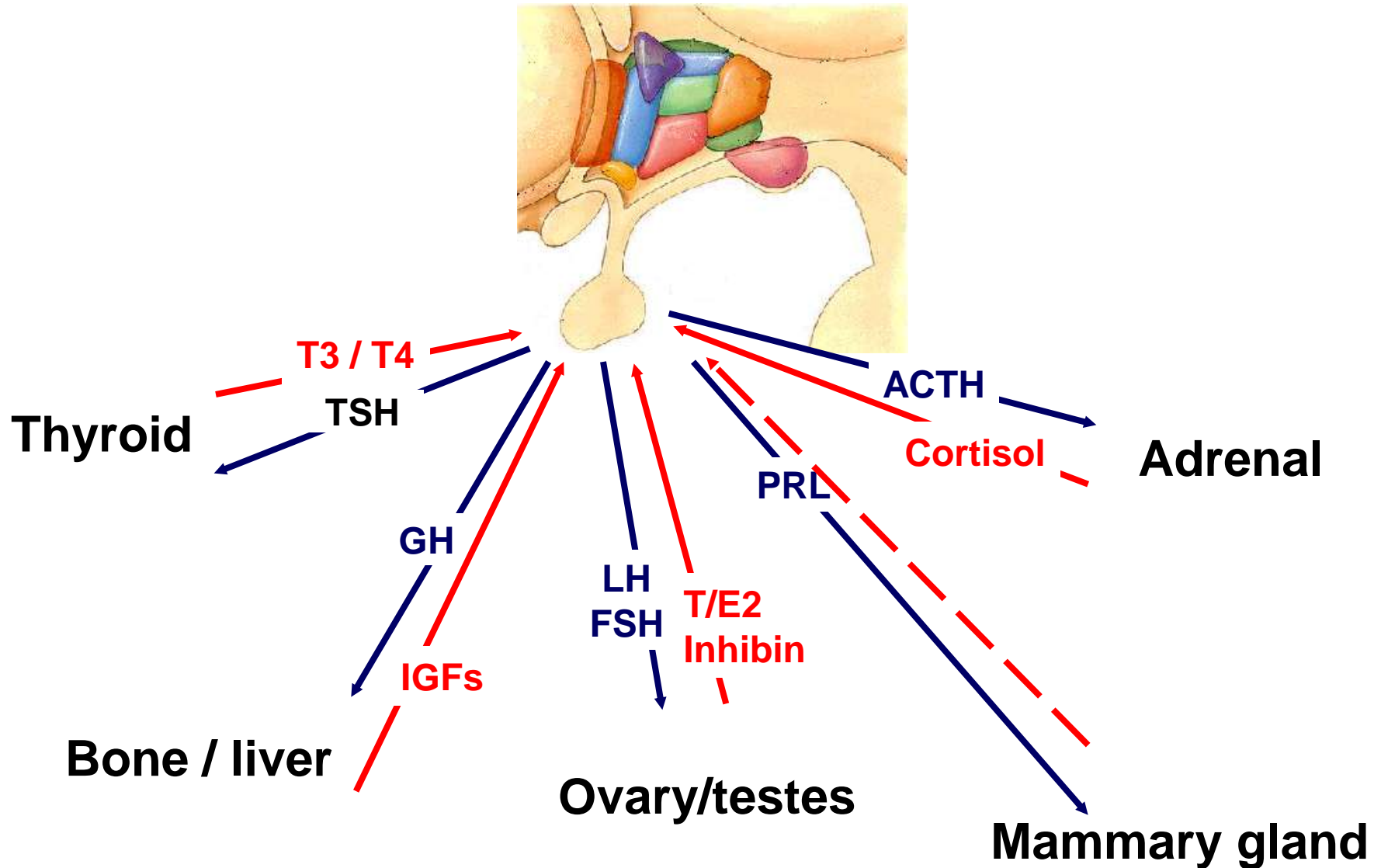
Functional units:

**HT - HP – peripheral glands**

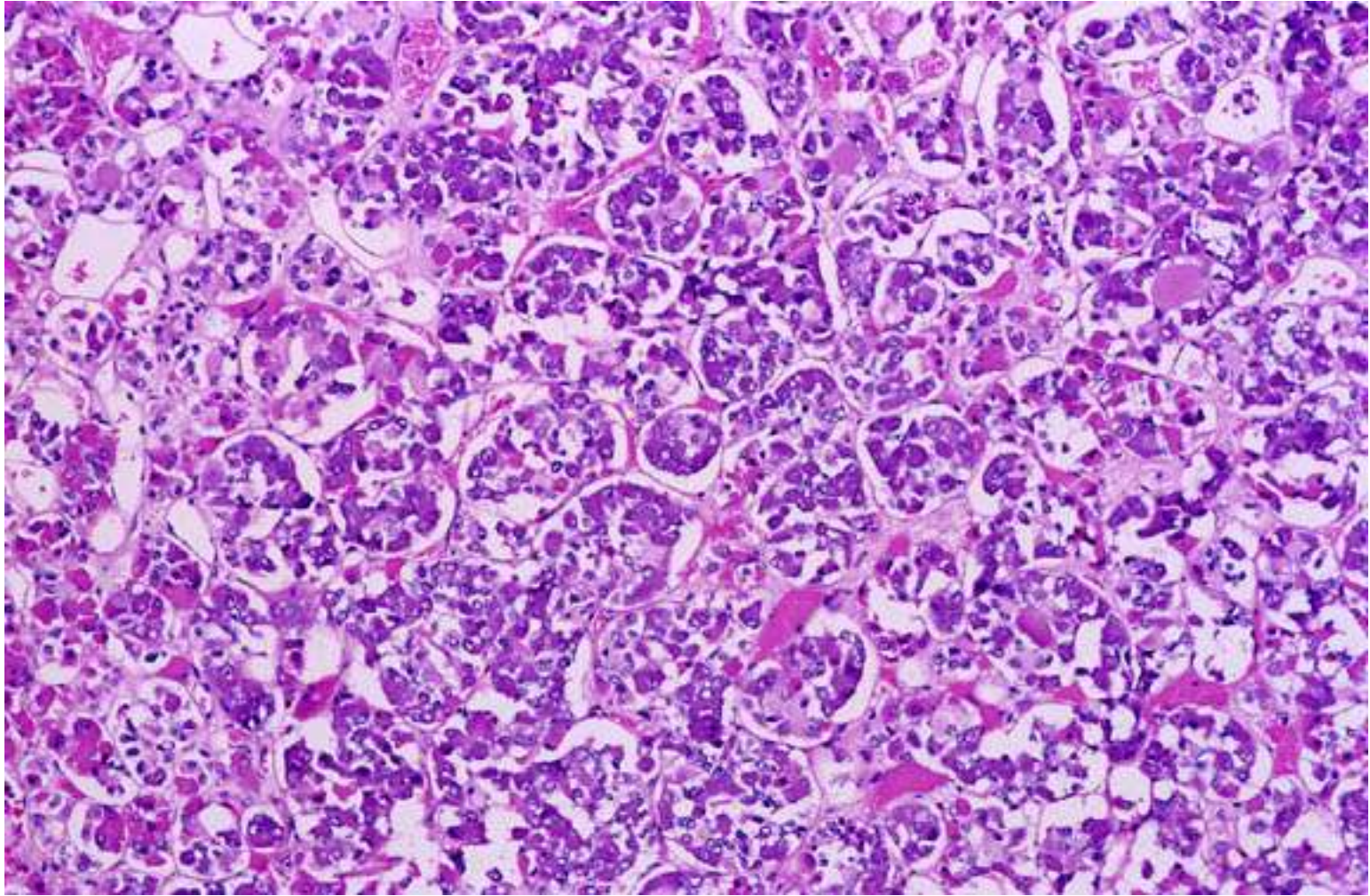
Interdependent secretions

Feed-forward and feed-back effects

# The 5 classical neuroendocrine axis

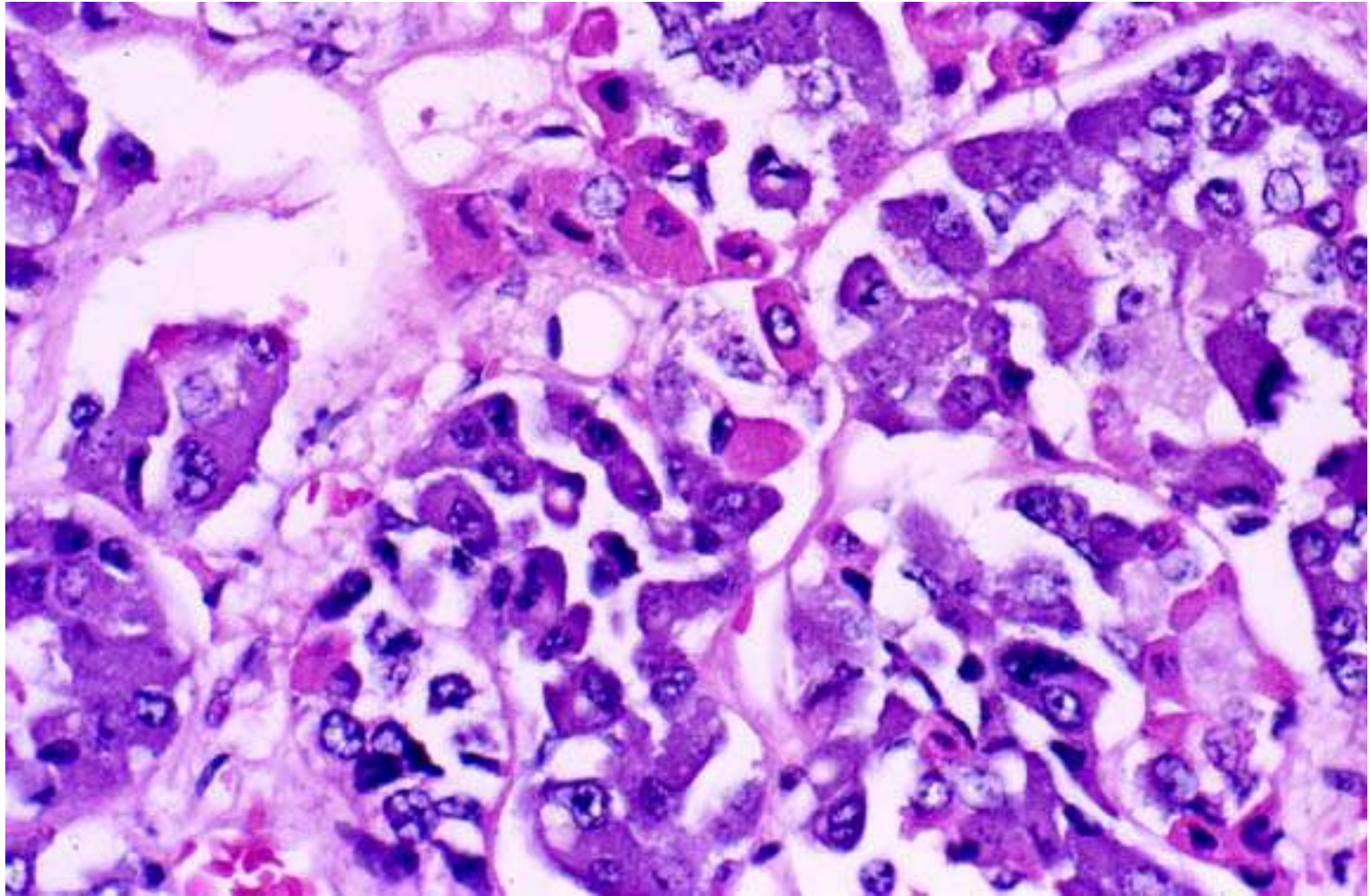






Anterior pituitary, H&E, x66





Anterior pituitary, basophils, acidophils, and chromophobes, H&E, x132

## **Acidophil cells:**

GH, PRL

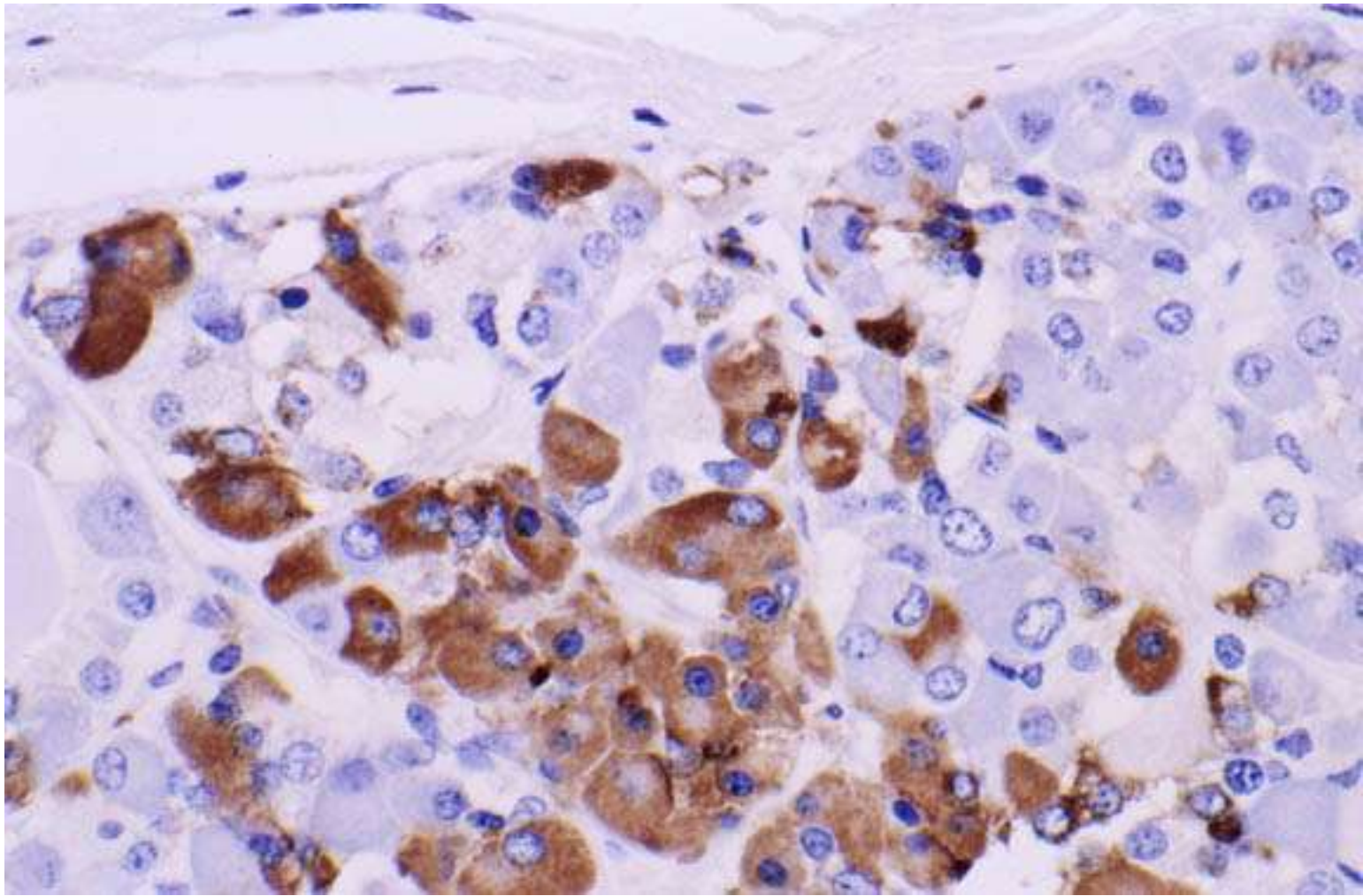
## **Basophil cells:**

TSH, LH et FSH, ACTH

## **Chromophobe cells:**

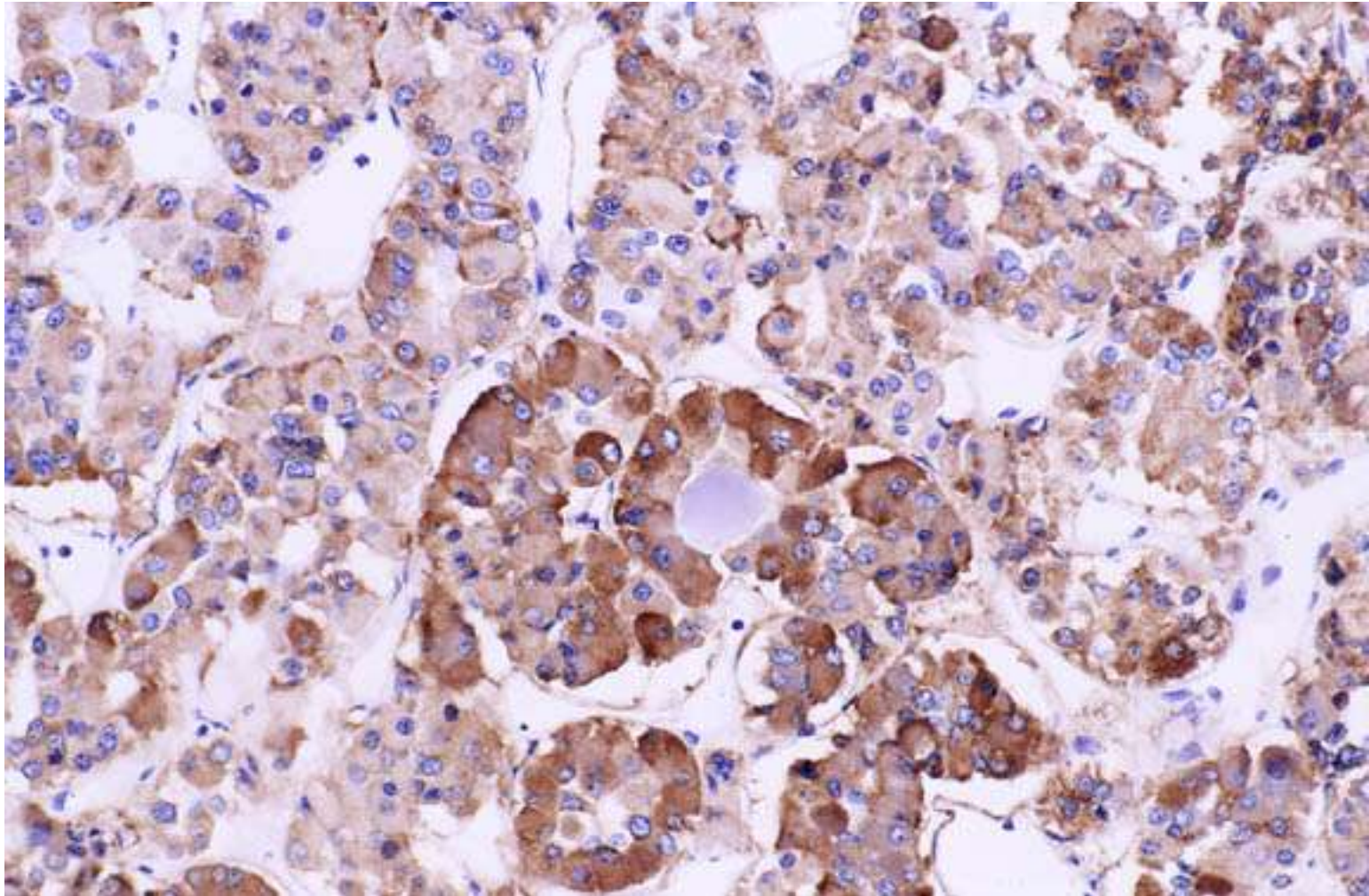
No hormonal content. Stem cells? Structure cells?

Folliculo-stellate cells: involved in keeping the pituitary structure



Anterior pituitary: immunohistochemistry prolactin  
(immunoperoxidase, x132)

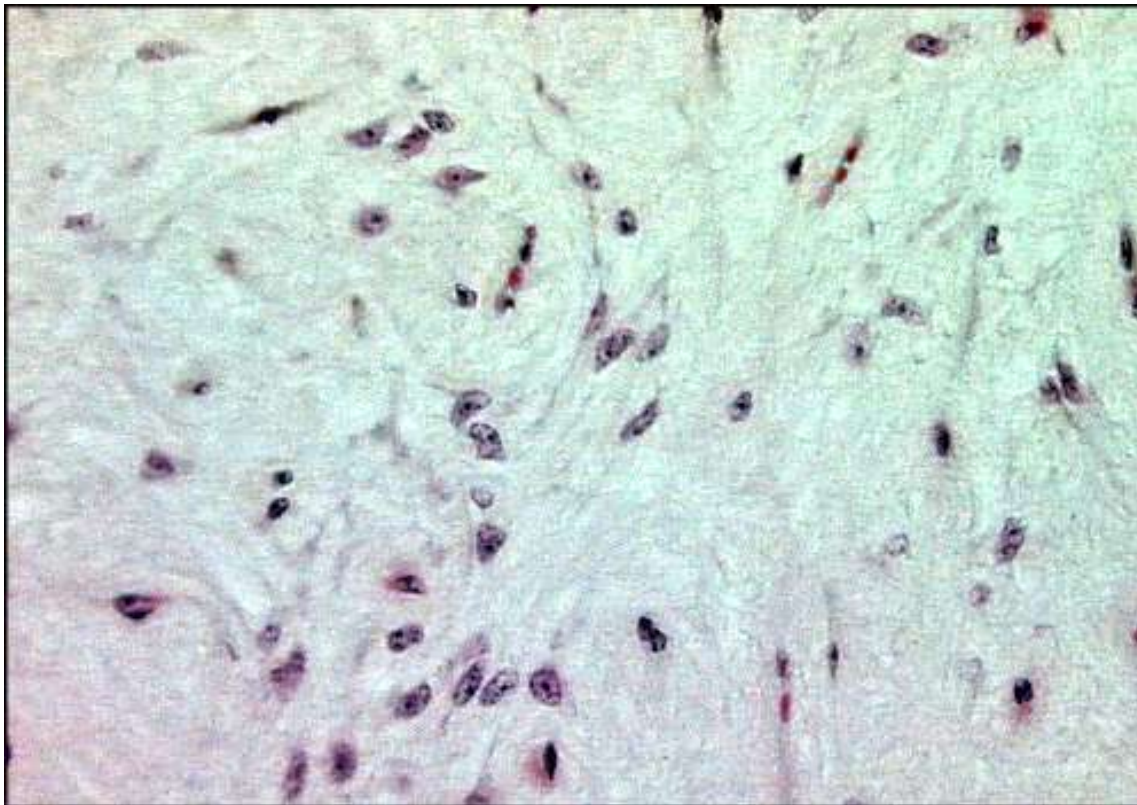




Anterior pituitary: immunohistochemistry [synaptophysine](#)  
(immunoperoxidase, x66)

The **posterior pituitary** content essentially contains neurosecretory neurons non myelinated, originating from the hypothalamic supra-optic and paraventricular nuclei

They secrete **oxytocin and vasopressin**.



Axonal prolongations, mixed with glial cells and capillaries



989762  
15-DEC-1954  
14:01  
30-MAR-2001  
IMAGE 48  
SER 1-5

MF 2.00

H

MAGNETOM Symphony  
H-SP VA13E  
+ : F A L

RP



SD 47



09:13  
22-FEB-2002  
IMAGE 26  
SER 1-3

NF 2.00

RA



05:23  
22-FEB-2002  
IMAGE 48  
SER 1-5

MF 2.00

RA

SP 19.5



09:07  
22-FEB-2002  
IMAGE 12  
SER 1-2

MF 1.15

AL

se1

65

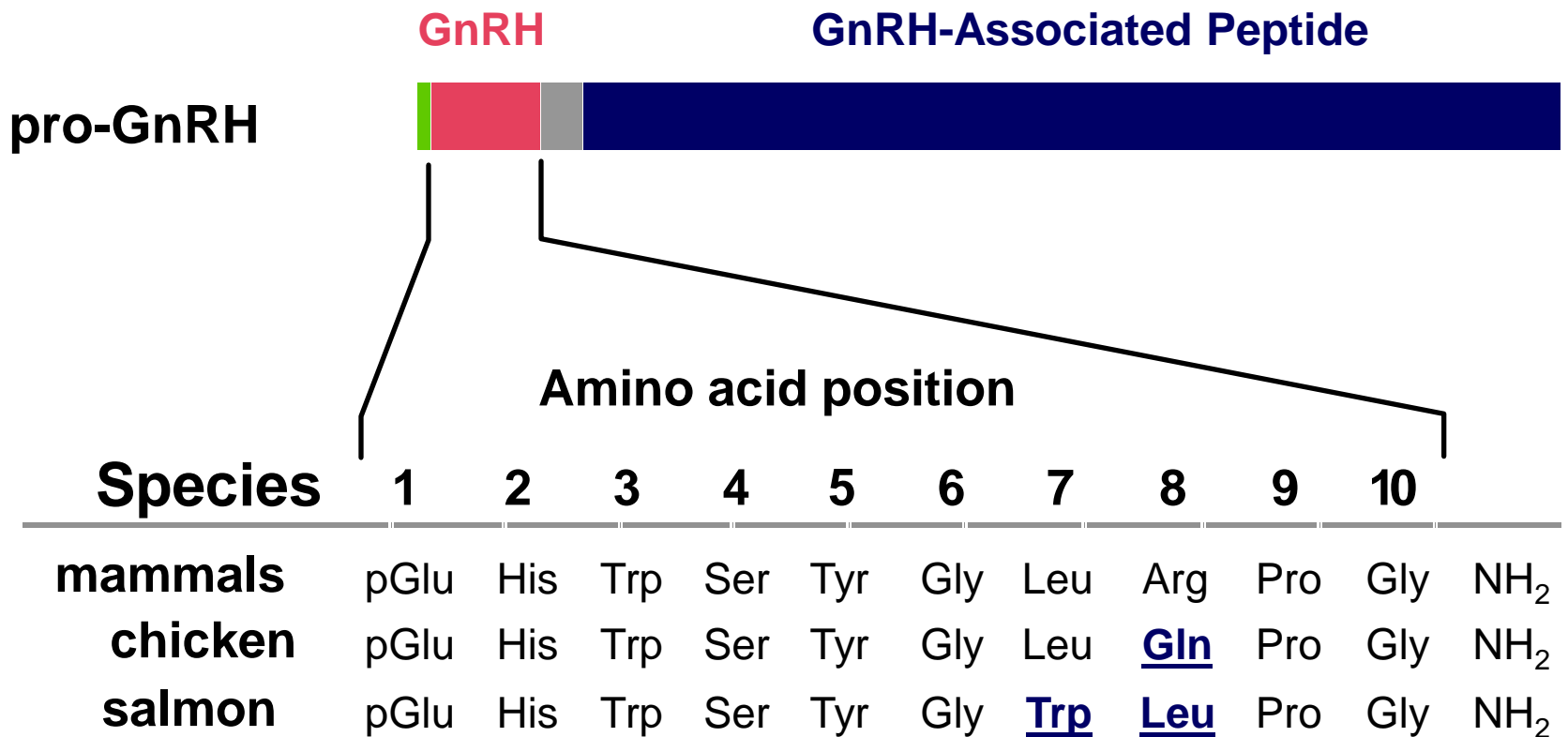
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FoV 230\*230

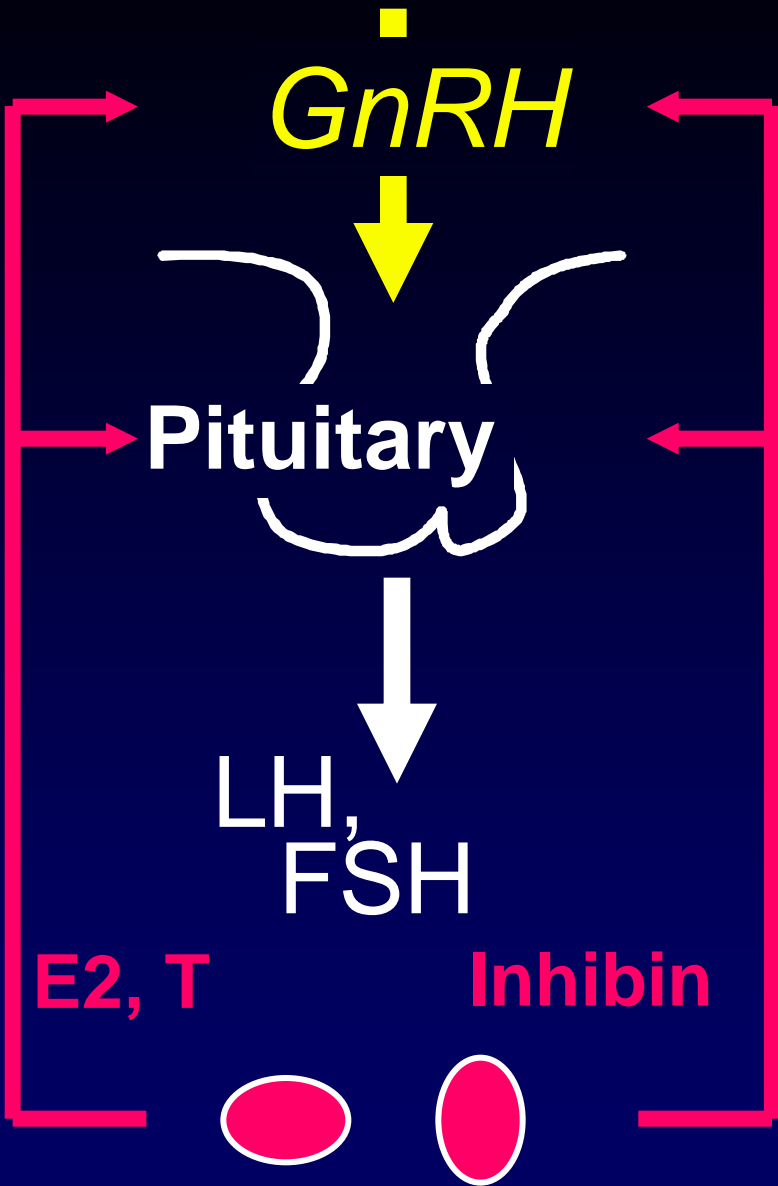


**The neuroendocrine  
reproductive axis and  
hypothalamic GnRH  
neurons**



# Conservation of primary structure of GnRH in vertebrates





**GnRH**

*Gonadotropin Releasing Hormone*

**Luteinizing Hormone**

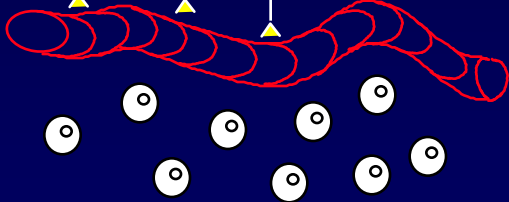
**Follicle Stimulating Hormone**

**Facilitation**

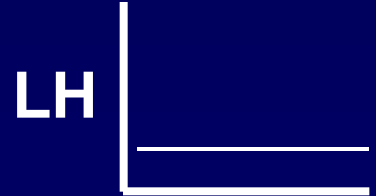
**Inhibition**

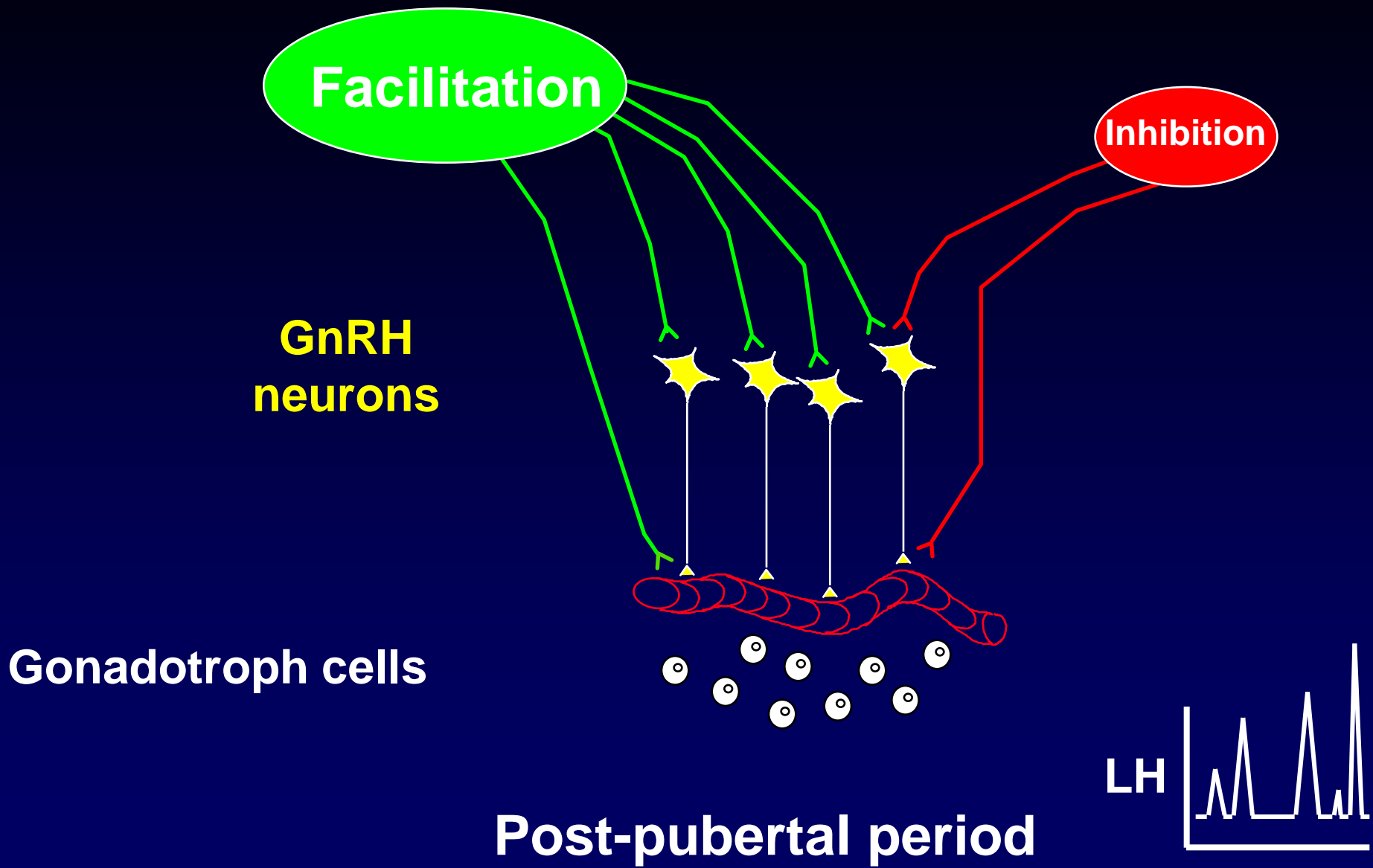
**GnRH neurons**

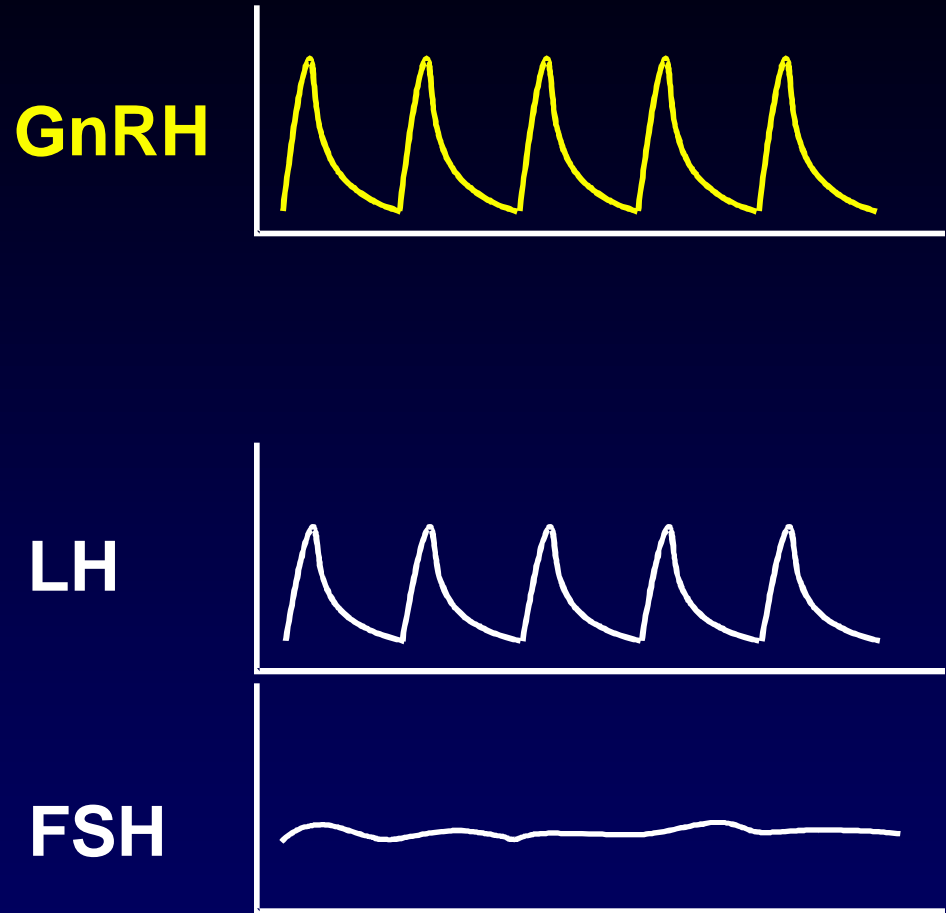
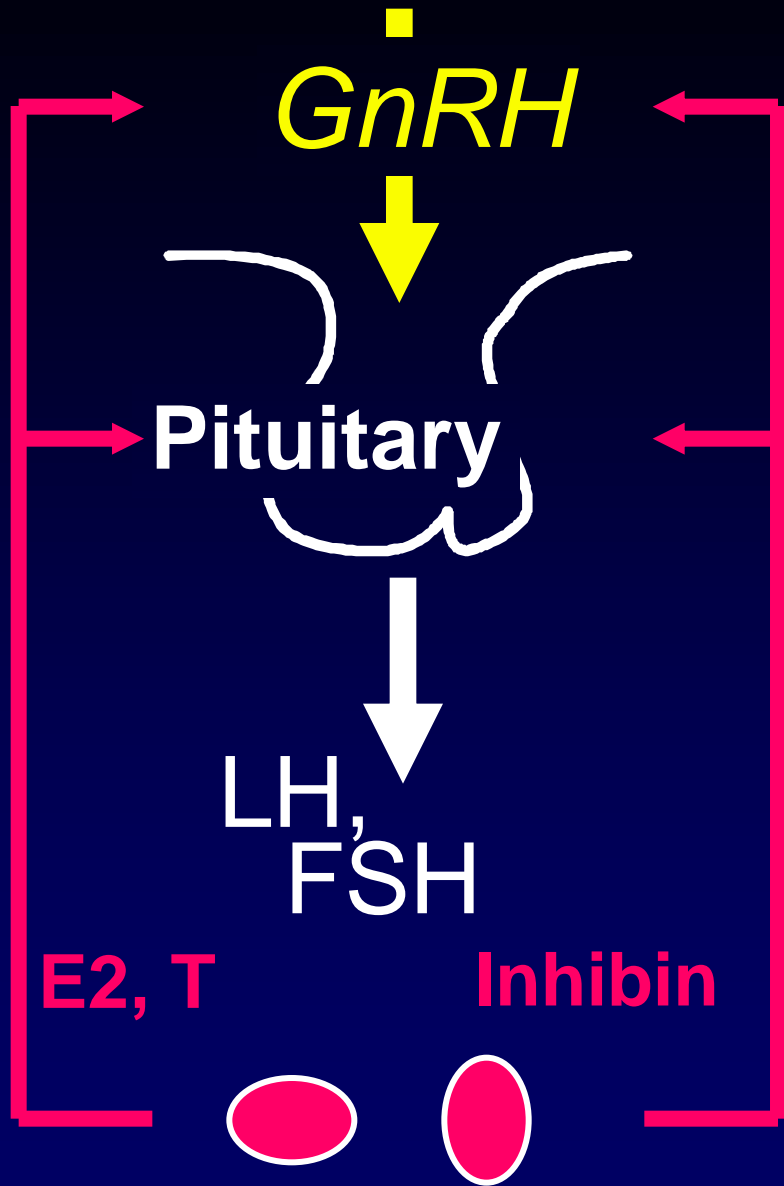
**Gonadotroph cells**

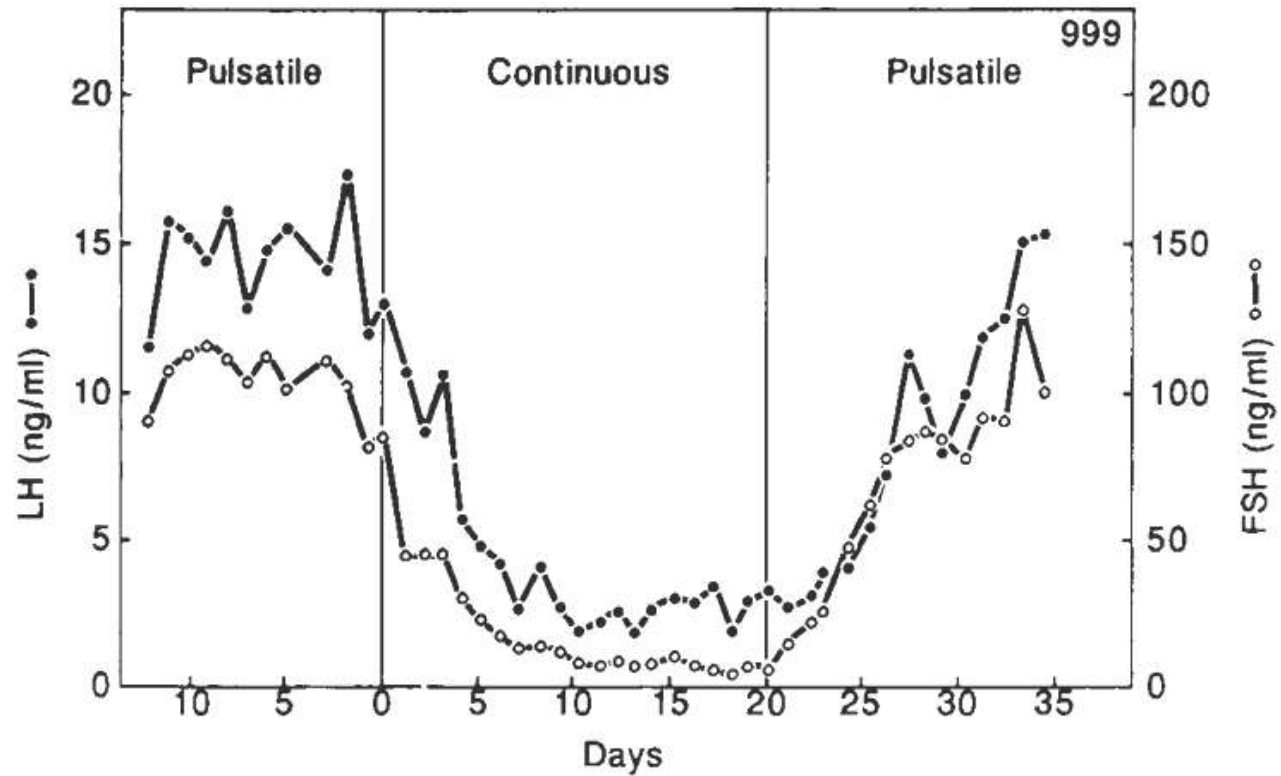


**Pre-pubertal period**









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**Belchetz et al, Science 1978;**

# Re-awakening of pulsatile GnRH secretion at puberty

