

ENDOCRINE SYSTEM



Prof. Dr. Azza Sajid

ENDOCRINE SYSTEM .. L#2

The Pituitary gland.

The gland is attached to the hypothalamus of the brain, which controls its activities. It is divided into 2 parts :-

- **The anterior pituitary** is a normal endocrine gland secretes many hormones, many of which control other endocrine glands:

- **Thyroid-stimulating hormone (TSH)** controls thyroxin from the thyroid gland.

Adrenocorticotropic hormone (ACTH) controls cortisol by the adrenal gland.

- **Luteinising hormone** controls testosterone by the testis.

- **Follicle-stimulating hormone (FSH)** controls estrogen by the ovaries.

Other hormones include:

- **Prolactin** stimulates milk production by the breasts.

- **Melanocyte stimulating hormone** causes darkening of the skin by producing melanin

- **Growth hormone** increases protein synthesis to stimulate growth (which mainly occurs during sleep), and also during fasting, it promotes fat breakdown to increase blood glucose, rather than protein breakdown.

THE RELATIONSHIP AMONG THE HYPOTHALMUS, ANTERIOR PITUITARY AND TARGET TISSUES .

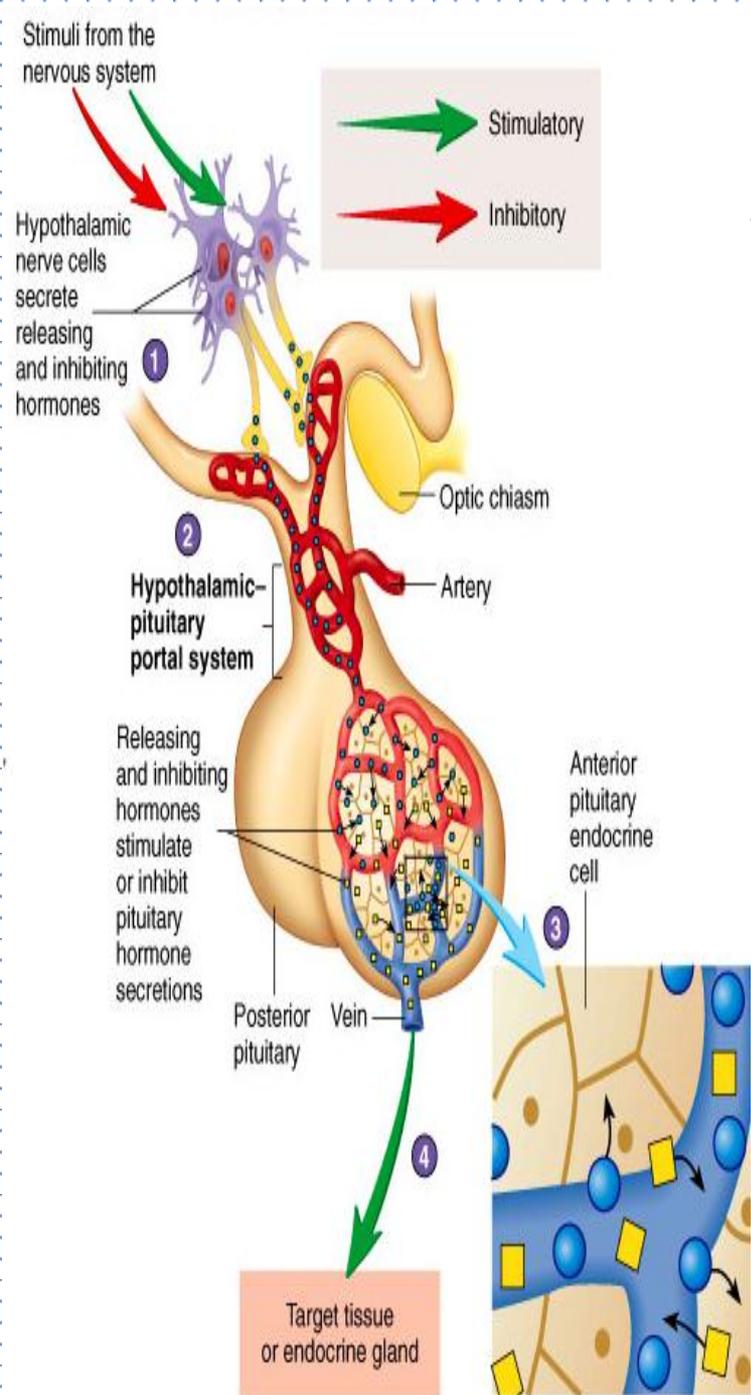
The anterior pituitary is controlled by the **hypothalamus**, which is connected to it by **blood portal system**. The modified neuron in the hypothalamus release

neurohormones into the portal capillaries and the neurohormones are then carried by the portal vein to the anterior pituitary.

The **neurohormones** may be of 2 types:

releasing hormones stimulate the release of a specific hormone (thus TRH releasing hormone that controls the release of TSH);

inhibitory hormones prevent the release of specific hormone.



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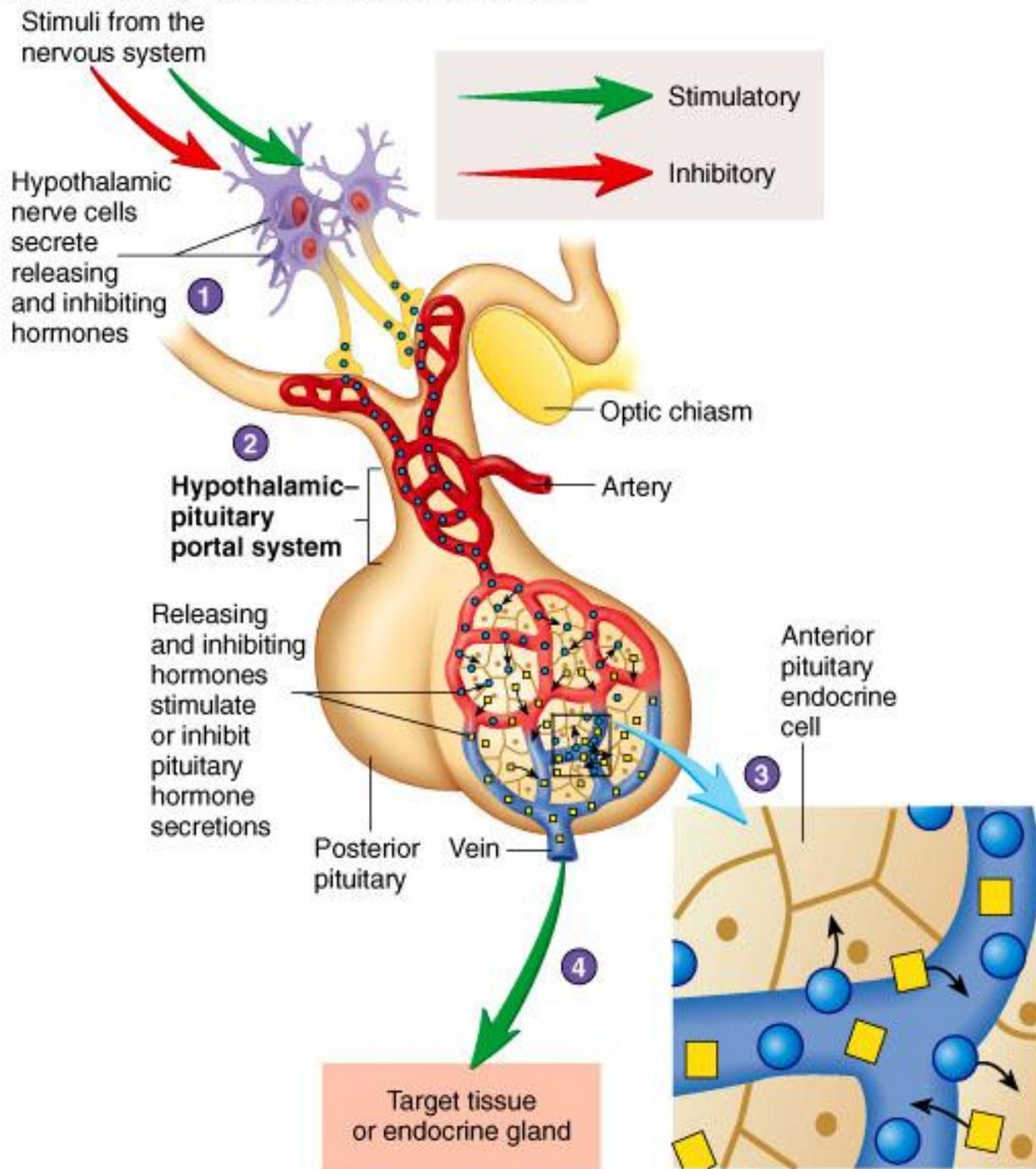
The **neurohormones** may be of 2 types: **releasing hormone** stimulate the release of a specific hormone (thus TSH releasing hormone controls the release of TSH); **inhibitory hormones** prevent the release of a specific hormone

1. Stimuli within the nervous system cause releasing and inhibiting hormones (*blue balls*) to be secreted from nerve cells of the hypothalamus.

2. Releasing and inhibiting hormones pass through the hypothalamic-pituitary portal system to the anterior pituitary.

3. Releasing and inhibiting hormones leave capillaries, bind to membrane-bound receptors, and influence the secretion of hormones from anterior pituitary cells.

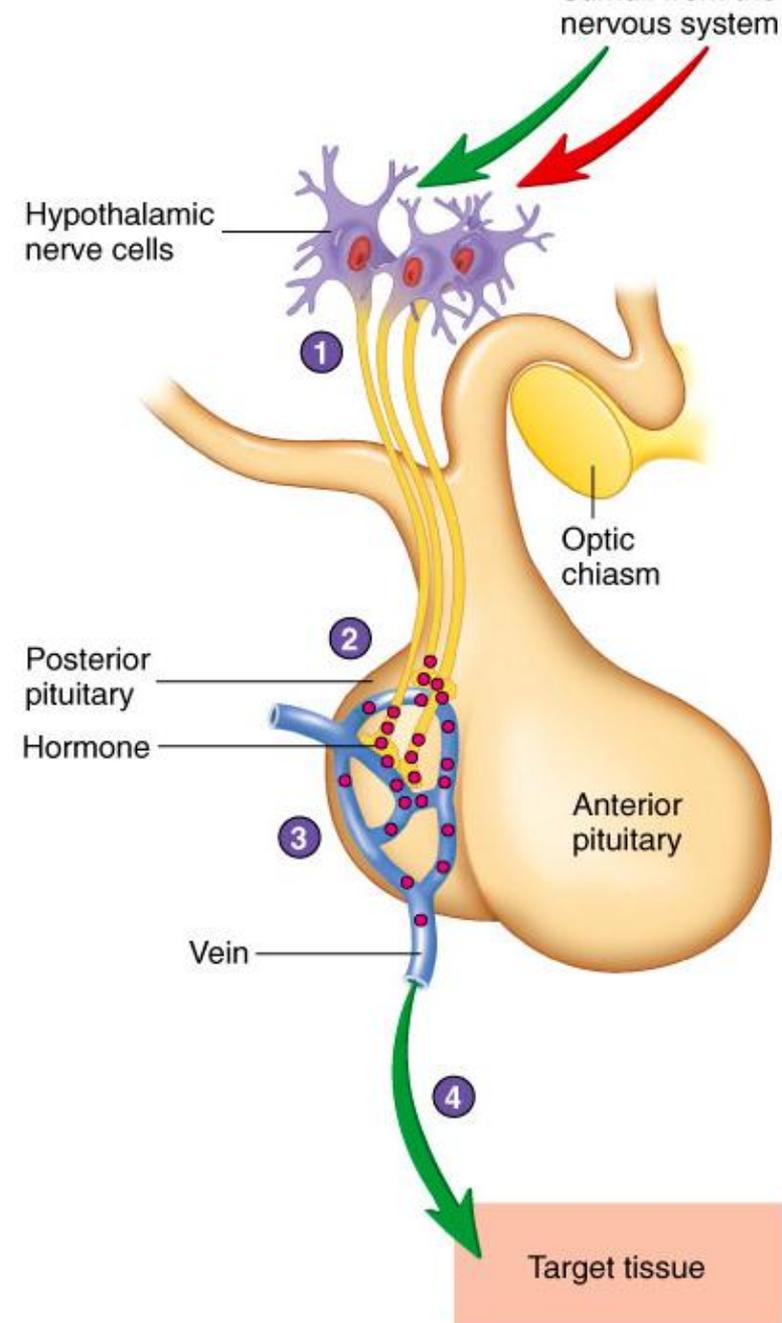
4. Anterior pituitary hormones (*yellow squares*) are carried in the blood to their target tissues (*green arrow*), which, in some cases, are other endocrine glands.



THE RELATIONSHIP AMONG THE HYPOTHALMUS, POSTERIOR PITUITARY AND TARGET TISSUES .

The posterior pituitary does not produce its own hormones, but **stores and releases neurohormones** that it received from the **hypothalamus**.

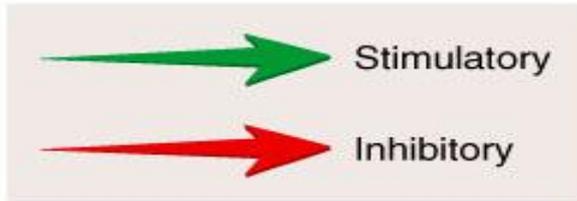
These neurohormones are transported through modified axons in to the posterior pituitary, where the hormones are stored in the axon endings. When needed, they are then released from the axons into blood capillaries.



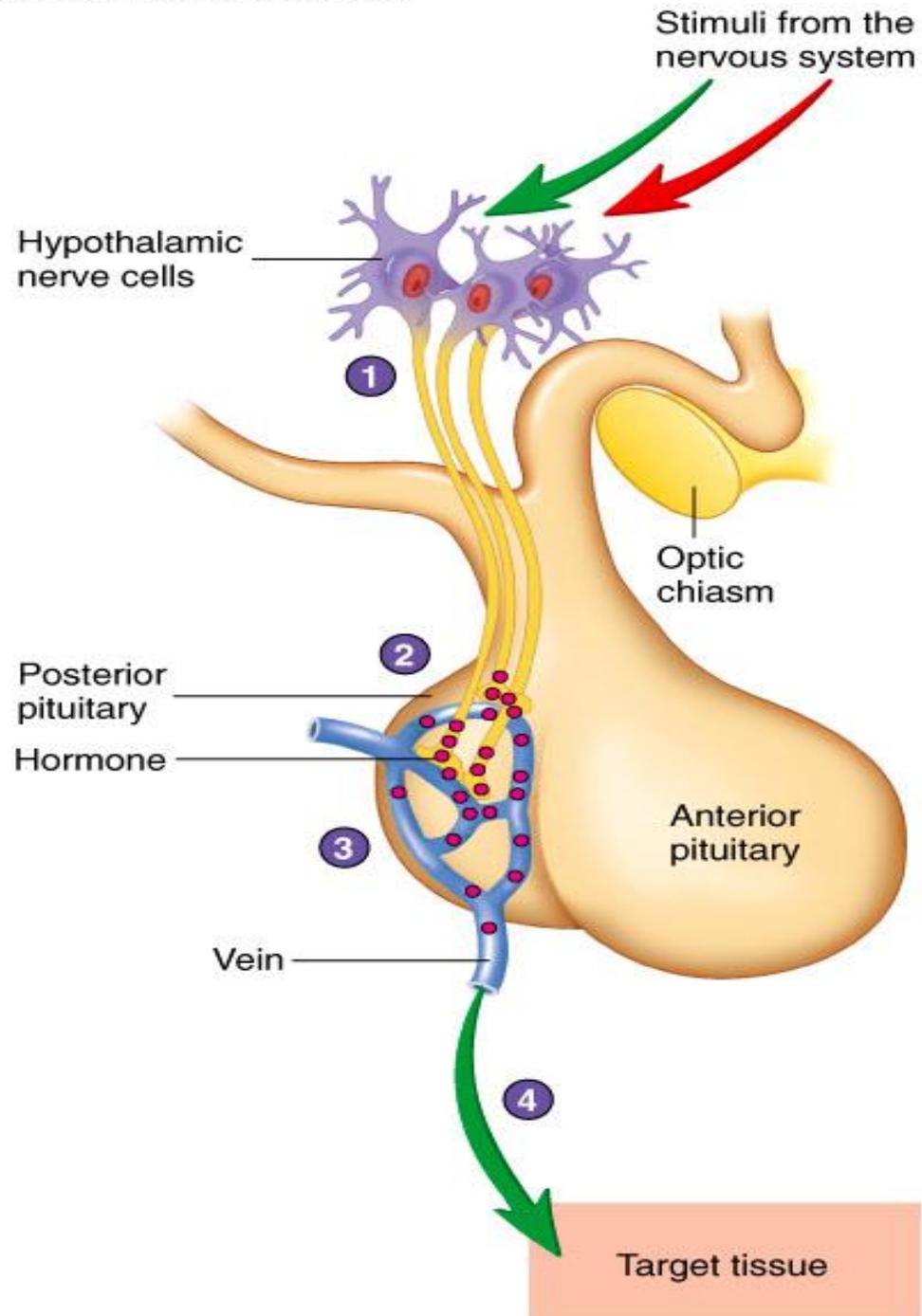
The **posterior pituitary** does not produce its own hormones, but **stores and releases neurohormones** that it receives from the **hypothalamus**. These neurohormones are transported through modified axons into the posterior pituitary, where the hormones are stored in the axon endings. When needed, they are then released from the axons into blood capillaries.

Anti-diuretic hormone (ADH) controls water reabsorption in the **kidney**.

Oxytocin contracts smooth muscles, e.g. in the uterus during birth and in the breasts during lactation.



1. Stimuli within the nervous system stimulate hypothalamic nerve cells to produce action potentials.
2. Action potentials are carried by axons of nerve cells to the posterior pituitary. The axons of nerve cells store hormones in the posterior pituitary.
3. In the posterior pituitary gland, action potentials cause the release of hormones (*red balls*) from the axons into the circulatory system.
4. The hormones pass through the circulatory system and influence the activity of their target tissues (*green arrow*).



HORMONES OF ANTERIOR PITUITARY GLAND:

1-Growth hormone (GH)or (somatotropin)

It is a protein.

- 1-stimulates growth in most tissues
- 2-increases amino acids uptake and protein synthesis .
- 3-increases breakdown of lipids release of Free fatty acids for energy .
- 4-increases glycogen synthesis and increases blood glucose level .

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- GH play important role in regulating blood nutrient level after a meal and during fasting period.
 - Low blood glucose level and stress stimulate secretion of GH .
 - High blood glucose cause decreased secretion of GH .
 - GH secretion rhythm occurs: daily peak level of GH correlated with deep sleep .
 - Decreased blood glucose causes increased Secretion of GH .
 - Increased blood glucose causes decreased secretion of GH .

PATHOLOGICAL CONDITIONS & DISORDERS

Pathological conditions are associated with abnormal GH secretion ,in general hyposecretion or hypersecretion are the result of tumor in hypothalamus ,pituitary ,synthesis of abnormal GH and lack of receptors in the target tissues .

1-Chronic hypo-secretion of GH in infant and children cause **DWARFISM** .

2-Chronic hypersecretion of GH lead to **gigantism (acromegaly)** .

PITUITARY DWARFISM

Manifestation

1) Physical

- Normal till 4 years
- Dwarf (proportional)

2) Mental

- Normal
- Psychological problem

3) Sexual

- Normal
- Delayed puberty

HYPER SECRETION

Before puberty (GIGANTISM)

- 1) Overgrowth of all bones (height 8-9 feet)
- 2) Overgrowth of soft tissues
- 3) Hyperglycemia → DM
- 4) Local effect

After puberty (ACROMEGALY)

- 1) Overgrowth of terminal skeleton
 - Prognathism
 - Hands and feet (acromegaly)
- 2) Overgrowth of soft tissues
 - Hepatomegaly, renomegaly
- 3) Hyperglycemia → DM
- 4) Local effects

2-THYROID STIMULATING HORMONE (TSH):

- × A glycoprotein
- × Stimulates thyroid gland to synthesize and secrete of thyroid hormones .
- × **TRH → TSH → THYROID HORMONES**
- × TSH is controlled by TRH from the hypothalamus and thyroid hormones from thyroid gland .

3-ADRENOCORTICOTROPIC HORMONE(ACTH) :

- × Peptide hormone
- × Stimulates the secretion of cortisol from the adrenal cortex .
- × ACTH and MSH bind to melaonocytes in the skin pigmentation .

- × CRH → ACTH → CORTISOL

4-MELANOCYTE STIMULATING HORMONE (MSH) :

- × Bind to membrane bond receptors on skin melanocytes and stimulate increase secretion melanin in the skin .
- × **5-Prolactin :**
- × A protein
- × Play important role in milk production in the mammary gland of lacting females .
- × Enhance progesterone secretion of the ovaries after ovulation .Unknown in male .
- × Prolactin is controlled by PRH and PIH .

6-GONADOTROPINS HORMONES

- × Glycoprotein hormone .
- × Promote the growth and function of gonads(ovaries and testes)
- × The 2 major important hormones are:
- × Luteinizing hormone (LH)
- × Follicle stimulating hormone (FSH)
- × Stimulate the production of gametes sperms in the testes ,oocytes in the ovaries

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- × LH ,FSH control the production of reproductive hormones:
 - × 1-Estrogen and progesterone in the ovary
 - × 2-testosteron in the testes .
 - × LH and FSH are controlled by the hypothalamic releasing hormones (GnRH)
 - × GnRH \longrightarrow LH and FSH \longrightarrow estrogen &teststeron

HORMONES OF POSTERIOR PITUITARY

1- ADH (ANTI DIURETIC HORMONE)

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- × It is named antidiuretic hormone because it prevents the output of large amount of urine (diuresis).
- × It is called vasopressin because it constricts blood vessels and raises blood pressure when large amount are released.
- × It is synthesized in the hypothalamus and released by posterior pituitary in response to action potential from the axon terminal, to the blood and carried to the primary target tissue (kidney tubules).
- × ADH promotes the water retention in the kidney tubules and reduces urine volume.
- × The secretion rate for ADH changes in response to alterations in blood osmolality and blood volume .Increased osmolality (increased concentration of solutes in the solution) results in:
 - Indirect stimulation of ADH by: increased frequency of action potential in osmoreceptors (specialized neurons synapse with ADH neurosecretory cells in the hypothalamus resulting in an increased action potential in the axon of ADH neurosecretory cells leading to increase ADH secretion.
 - Direct stimulation of ADH neurosecretory cells.
- ❖ Decreased osmolality results in less secreted ADH.

2. OXYTOCIN

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- × Oxytocin is a neuropeptide synthesized by neurocells in the hypothalamus, and then transported through the axon to the posterior pituitary, where it is stored in the axon terminals.
- × Oxytocin stimulates smooth muscle contraction of the uterus to help in the expulsion of the fetus from the uterus during delivery.
- × It causes the expulsion of the uterine epithelium and a small amount of blood during menses.
- × It is responsible for milk ejection in lactating females.

Thanks