Hypothalamus

By

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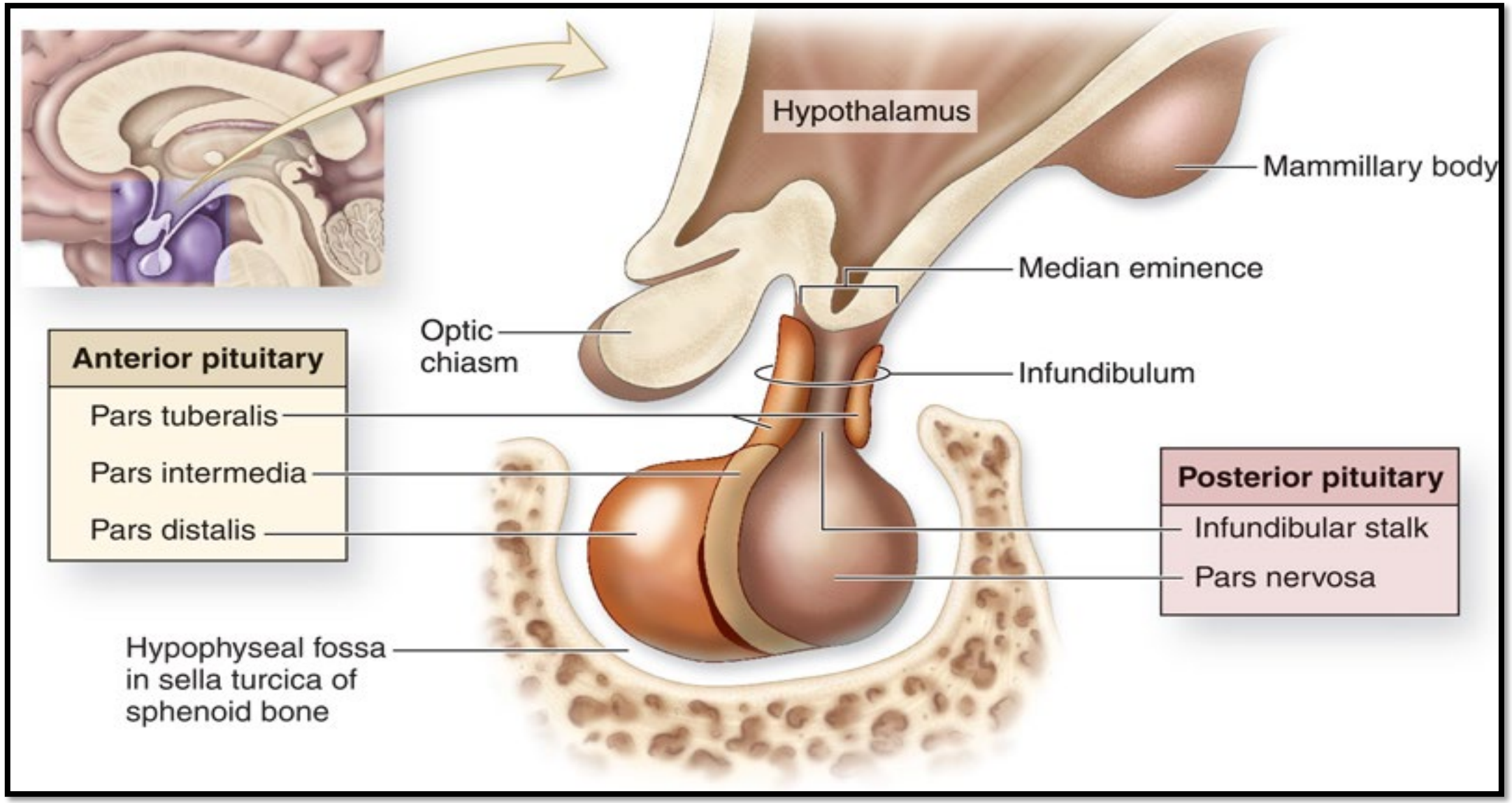
Learning outcomes:

- **At the end of the lecture, you will be able to:**

1. Explain the location and the functions of the hypothalamus.

Location of hypothalamus

- Hypothalamus is **located at** the base of brain, just above pituitary gland and below the thalamus on either side of the **3rd ventricle**.


Hypothalamus
Mammillary body
Median eminence
Optic chiasm
Infundibulum
Anterior pituitary
Pars tuberalis
Pars intermedia
Pars distalis
Posterior pituitary
Infundibular stalk
Pars nervosa
Hypophyseal fossa in sella turcica of sphenoid bone

Functions of hypothalamus

1- Regulation of autonomic nervous system

Hypothalamus controls the autonomic functions, as evidenced by the followings:

a) Stimulation of posterior hypothalamic area ➔

sympathetic effects **e.g.** ↑ HR, ↑ ABP, pupillary dilatation & ↑ catecholamines secretion of from suprarenal medulla.

b) Stimulation of anterior hypothalamic area ➔

parasympathetic effects **e.g.** ↓ HR, ↓ABP.

2-Regulation of blood glucose level:

- Under normal conditions, glucose is the **only substrate used by the brain** for energy metabolism.

- It is supplied moment by moment due to **lack of glycogen stores**.

- Hypothalamus contains **glucoreceptors** stimulated by **hypoglycemia**.

-Hypoglycemia triggers **counter-regulatory mechanisms** to raise the blood glucose level.

- These mechanisms include:

a) ↑ secretion of adrenaline, growth hormone & cortisol ➔ ↑ glycogenolysis, ↑ gluconeogenesis ➔ ↑ blood glucose level to normal.

b) Activation of hunger center (in hypothalamus) ➔ person feels hungry ➔ ↑ food intake ➔ ↑ blood glucose level.

3- Regulation of body osmolality and volume of body water:

- The hypothalamus regulates **body osmolality and volume of body water** by controlling both the **output** and the **intake of water**.

- **This control is conducted by 2 mechanisms:**

a) ADH

b) Thirst sensation (its center is in hypothalamus).

When osmolarity increases & blood volume decreases

i- ↑ **ADH** secretion → ↑water **reabsorption** from the kidney.

ii- ↑ **thirst** sensation → ↑water **intake.**

- Accordingly: blood volume ↑**es** & **osmolarity** ↓**es** to normal.

When osmolarity decreases & blood volume increases

i- ↓ **ADH** secretion → ↑water **loss** from the kidney.

ii- ↓**thirst** sensation → ↓ water **intake.**

- Accordingly blood **volume** ↓**es** & **osmolarity** ↑**es** to normal.

4- Regulation of endocrine glands:

a) Hypothalamic control of anterior pituitary gland: (vascular control)

- Through the hypothalamo-hypophyseal portal circulation between the hypothalamus and the anterior pituitary (adenohypophysis).

- The hypothalamus secretes **certain peptides** which are transported to the pituitary gland through the hypothalamic –hypophyseal portal circulation.

- **These hypothalamic peptides are of two natures:**

a) Releasing factors (hormones):

e.g.: - Thyrotropin (TSH). RF

- Corticotropin (ACTH). RF

- Gonadotropin (GTH). RF

- Growth H. RF

b) Inhibiting factors (hormones):

e.g.: - Prolactin inhibiting factor (PIF).

- Growth H inhibiting factor (GIF).

b) Hypothalamic control of posterior pituitary gland: (**Nervous control**)

- A **hypothalamo-hypophyseal tract** arises from **supra-optic (SO)** and **paraventricular (P.V) nuclei** and ends in the posterior pituitary (neurohypophysis).

- The **S.O nucleus secrets ADH** and **P.V nucleus secrets oxytocin**. These hormones are then transported along the hypothalamic-hypophyseal tract to be stored in the post pituitary. Stimulation of S.O and P.V ➔ release of these hormones from the posterior pituitary into blood stream.

c) Hypothalamic control of suprarenal medulla: (**Nervous control**)

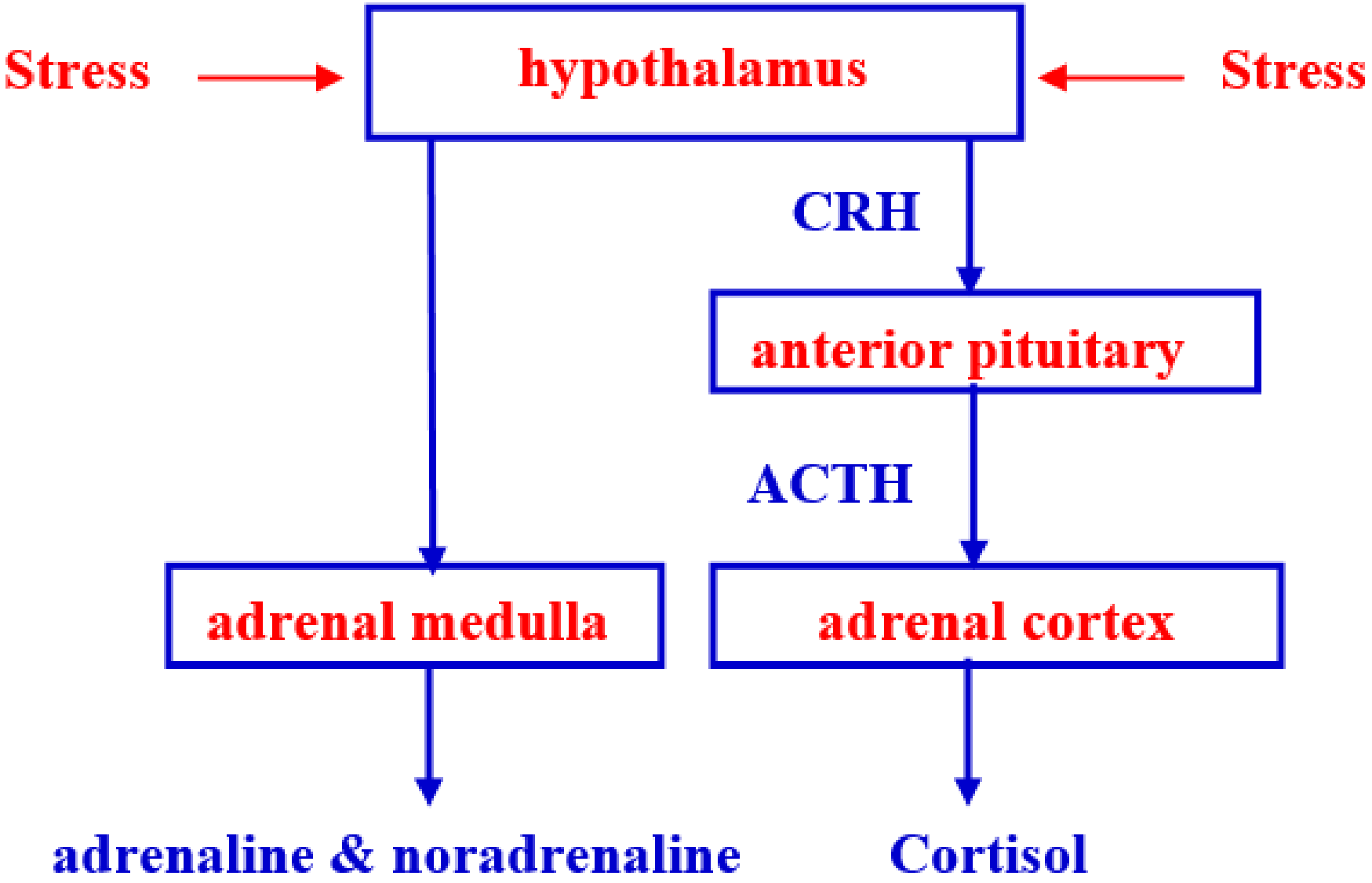
- **Hypothalamic fibers** affect the **adrenaline-secreting center** in the medulla oblongata, which in turn affect the activity of SRM that secretes adrenaline and noradrenaline in the blood stream.

5- Regulation of body response to stress:

- **Hypothalamus integrates both the endocrinal and neural responses to stress conditions** **e.g:** hemorrhage, hypotension, hypoxia, hypoglycemia & muscular exercise.

- Hypothalamus stimulates the secretion of **cortisol** (from adrenal cortex) and **adrenaline** (from adrenal medulla) during exposure to stress.

- **Both cortisol and adrenaline**, participate in the defense against stress by several ways.


Stress
hypothalamus
Stress
CRH
anterior pituitary
ACTH
adrenal medulla
adrenal cortex
adrenaline & noradrenaline
Cortisol

6- Role of hypothalamus in (diurnal) circadian rhythm:

- **Several body functions undergo regular variation of their level within 24 hours of day e.g.**

a) Body temperature

b) Blood pressure

c) Secretion of hormones as: cortisol, growth H, melatonin.

- The **biological clock** responsible for this regulation is the **supra-chiasmatic nucleus** (SCN) of hypothalamus which receives information about light and darkness directly from the retina of the eye.

7- Regulation of body weight and food intake.

8- Regulation of body temperature.

References

1. Costanzo, Linda S. "BRS Physiology (Board Review Series)." (2018).
2. Ganong, William F. "Review of medical physiology." (2020).
3. Hall, John E and Hall, Micheal E. “Guyton and Hall Textbook of medical physiology." (2021).