UNIVERSITY OF WESTERN ONTARIO

Anatomy 9535. Anatomical Foundations of Neuroscience

HYPOTHALAMUS and NEUROENDOCRINOLOGY

Overview of hypothalamic functions

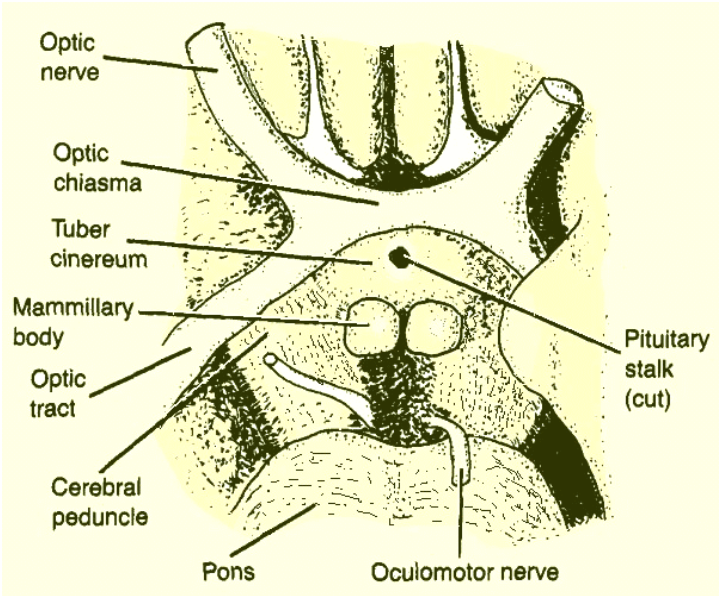
Afferents of the hypothalamus include fibers from the amygdala, septal area and the brain stem.

Some hypothalamic neurons directly sense changes in hormone concentrations, osmotic pressure, and temperature of the blood.

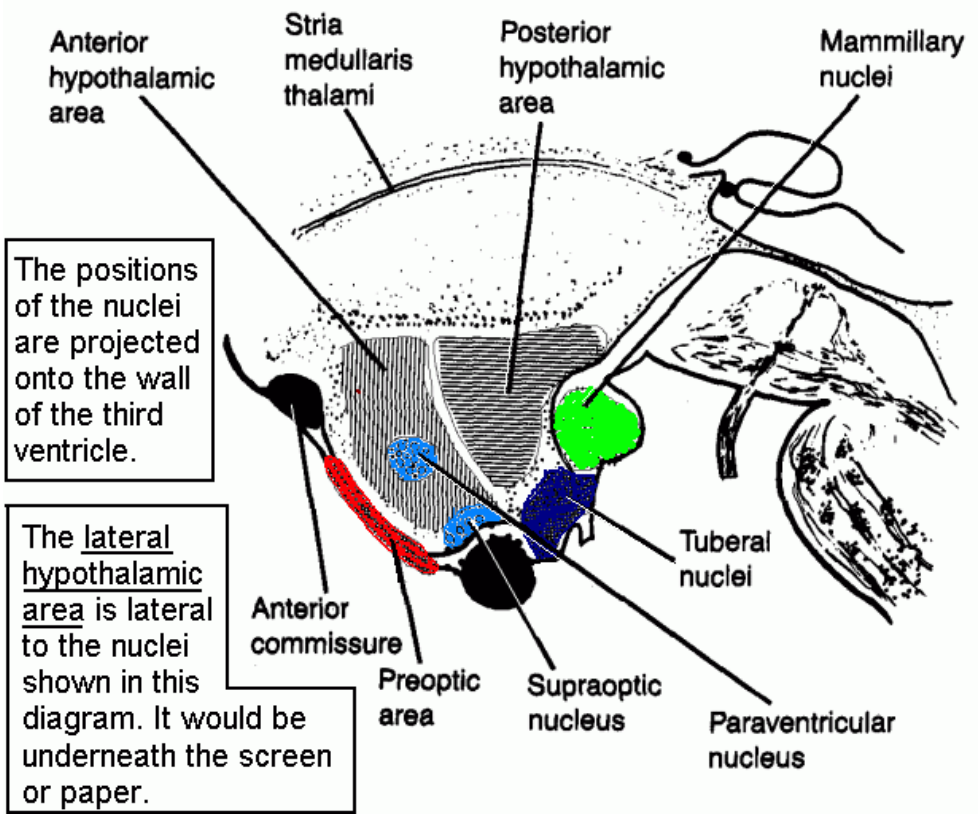
Hypothalamic **efferent** fibers go to the brain stem and spinal cord, for control of autonomic and other involuntary functions.

Some hypothalamic neurons secrete hormones, including those of the posterior lobe of the pituitary gland. Releasing factors enter the hypophysial portal vessels and control the secretion of secretion of anterior pituitary hormones.

The hypothalamus is the only part of the diencephalon visible on the surface of the brain.

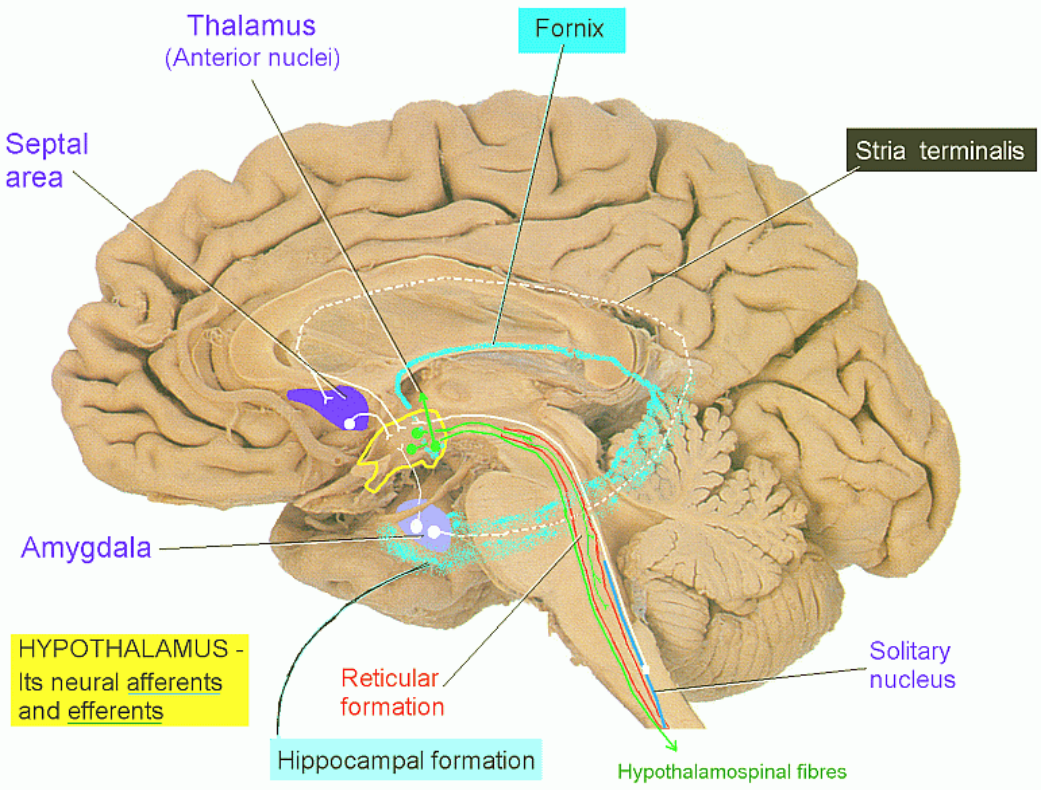


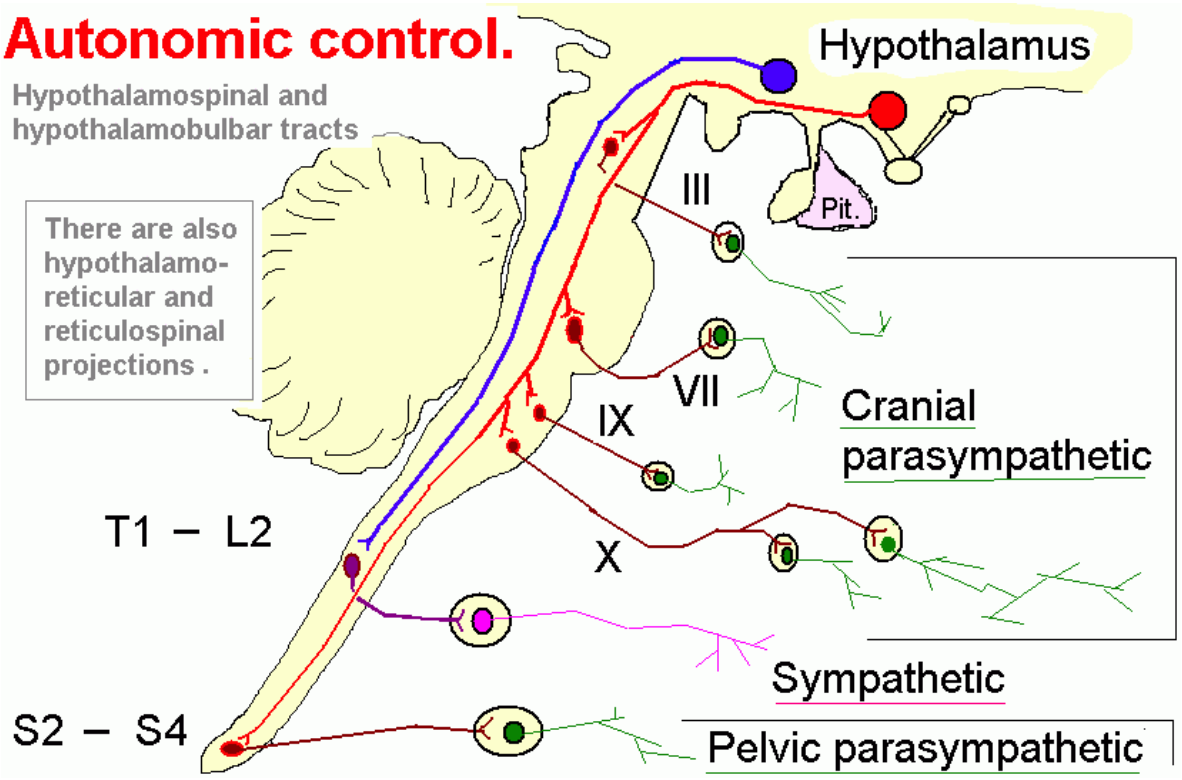
Nuclei of the medial hypothalamus (simplified)



The positions of the nuclei are projected onto the wall of the third ventricle.

The lateral hypothalamic area is lateral to the nuclei shown in this diagram. It would be underneath the screen or paper.





SOME HYPOTHALAMIC FUNCTIONS.

Thermoregulation. Thermometer neurons in anterior hypothalamic area. **Heat loss** neurons are also there : vasodilation , sweating .

Heat conservation neurons in posterior hypothalamic area: vasoconstriction , reduced sweating , piloarrection in furry animals .

Axons from anterior hypothalamus course through posterior hypothalamus .

Therefore, **destructive lesions in the :**

anterior hypothalamus cause -- temperature **up** .

posterior hypothalamus cause -- temperature **uncontrolled** .

Feeding behaviour.

"Satiety centre" in anterior ventral hypothalamus.

Stimulation --- inhibits eating

Destruction --- obesity (Needs bilateral lesions)

"Feeding centre" in lateral hypothalamic area.

Stimulation --- eating (due to hunger?)

Destruction --- anorexia (= loss of apetite) (bilateral)

[Information is mostly from animal experiments but similar effects of bilateral lesions in human brain have been described.]

Osmoregulation. Osmometer neurons in anterior hypothalamic area and in supraoptic nucleus.

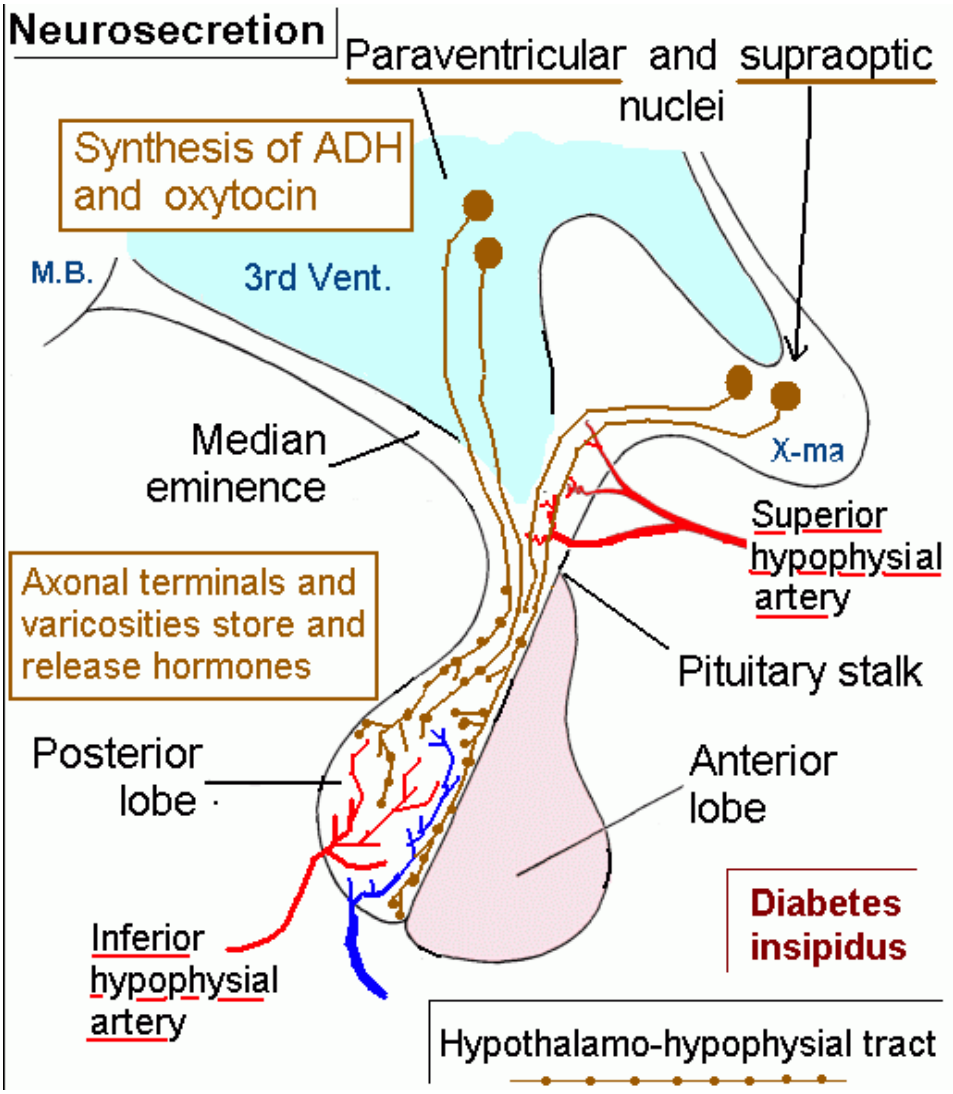
Raised osmotic pressure of extracellular fluids is a signal to conserve water by reducing output of urine.

Neurosecretory cells, mostly ones in supraoptic nucleus, synthesize antidiuretic hormone (= ADH = vasopressin).

ADH moves by axonal transport to axonal terminals close to blood capillaries in posterior lobe of pituitary gland.

Action potentials in ADH neurosecretory neurons release stored ADH.

ADH acts on kidney - makes distal and collecting tubules reabsorb more water, thus reducing the volume excreted.



More osmoregulation. Receptors in walls of large veins respond to changes in the volume of blood returning to the heart. Decreased volume tells the hypothalamus to order increased drinking. This is subjectively experienced as **thirst**.

Parts of the diencephalon (zona incerta, subfornical organ, hypothalamus) respond to circulating levels of **angiotensin**, a peptide that increases drinking and raises blood pressure.

The renin - angiotensin system is a big subject in its own right, but it isn't neuroanatomy ! Angiotensin levels control the secretion of aldosterone, the adrenocortical hormone that tells the kidney to retain sodium ions and accompanying water molecules.

Sleep.

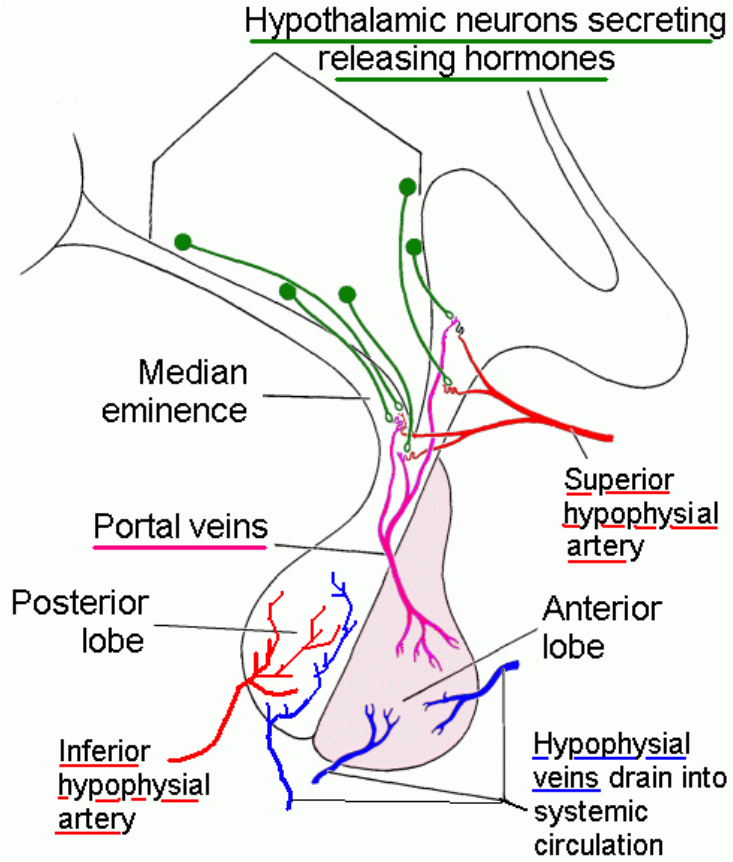
1. Neurons in the suprachiasmatic nucleus fire at an increased rate at night.
2. Histamine-producing hypothalamic neurons have extensive, branching axons that go to numerous places - thalamus, cerebral cortex etc. These neurons are active when waking up.
3. Consciousness is usually attributed to continued signaling from the reticular formation of the brain stem to the thalamus and cortex: the ascending reticular activating system.

Memory.

Mamillary bodies are part of a circuit that also includes hippocampal formation, anterior nuclear group of thalamus and cingulate gyrus. This system is widely believed to form new memories.

In Korsakoff's psychosis there can be degeneration of the mamillary bodies and loss of ability to form new memories, with confabulation.

CONTROL OF THE ANTERIOR LOBE OF THE PITUITARY GLAND



Anterior pituitary hormones.

Corticotrophin (ACTH) → Adrenal cortex → Glucocorticoids

Thyrotrophin (TSH) → Thyroid gland → T3 and T4

Somatotrophin (Growth hormone, STH) → Growth

Gonadotrophins

Folliculotrophin (FSH) → Ovarian follicle → Oestrogens

Luteotrophin (LH) → Ovulation. Corpus luteum → Progesterone

Prolactin → Mammary gland