



Physiology of Excitable tissue

L9

Autonomic Nervous System II

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The effect of sympathetic N.S .



The effect of sympathetic stimulation is usually diffused one that spread allover the body.

?

So we can't study the sympathetic N.S. excitation or stimulation to each organ separately

but we can do:

- 1. either generalized stimulation.**
- 2. generalized inhibition.**

Effect of sympathetic stimulation



General stimulation of sympathetic nervous system leading to a state like anxiety or fear.

(Fight or Flight)

The external changes include:

- 1. Pallor of skin:-** due to vasoconstriction of the skin BV in order to pool (direct) the blood into the vital organs.
- 2. Exophthalmus= dilatation of the pupils.**
Due to lid retraction as a result of CNS over stimulation.
- 3. Tremor of the fingers & increase in muscle tone.**
- 4. Erection of hair** most prominent in animals.

Internal changes:

Prepare the body with high energy & O₂.



1. ↑ respiratory rate & depth:-

to increase O₂ intake as well as CO₂ wash out.

2. ↑ heart rate & force of contraction:-

(↑ inotropic effect → ↑ cardiac output)

3. ↑ blood pressure, especially the systolic pressure.

4. ↓ GI tract motility & absorption

so may cause diarrhea (frequent bowel motion).

5. ↑ glucose level in blood like the effect of different hormones that we call as Glycogenic hormones.

Effect of Adrenal Medulla



The changes of sympathetic stimulation are
prolonged & more diffused

by

The effect of adrenaline & Noradrenaline of the
suprarenal glands.

**If continue for longer period it may cause
exhaustion.**

Effect of removal of sympathetic



Removal of sympathetic system doesn't cause death

But the subject will be extremely sensitive to any changes in the environment

(inside & outside the body)

If these changes are not controlled may lead to death:-

Changes in body temperature

Decrease in O₂ or increase of CO₂ atmosphere.

Minor bleeding.

Decrease in glucose level

the sympathetic is responsible for compensatory changes in the body against these physiological minor changes.

Types of the sympathetic fibers



1. Reflexely acting n.f.:-

Usually not active during rest but excited on receptor stimulation, like **Baroreceptors**, Carotid sinuses lead to reflex causing increased heart rate & vasoconstriction of BV.

2. Continuously active n.f.:-

some sympathetic f. to heart, to blood vessels, ciliary muscles of pupils.

3. Fibers that are stimulated only on severe stress or emergency:-

those to adrenal gland.

Parasympathetic N.S.:



The effect of parasympathetic N.S. can be stimulated locally to certain organs not generalized like sympathetic

Why ?

The effect of parasympathetic N.S. nearly always occur reflexly

Effect of parasympathetic stimulation



- 1. Fibers to lacrimal gland:** cause lacrimation.
- 2. Fibers to the eyes & ciliary muscle:** cause constriction of pupil, sinking of the eye in the orbit .
- 3. Fibers to salivary gland** cause salivation, if removed lead to dryness of mouth.
- 4. Fibers to GIT:** increase motility & secretion.
 - Fibers to esophagus** cause secondary peristalsis.
 - Fibers to stomach:** Increased gastric & HCL secretion.
 - Fibers to Pancreatic, gallbladder, intestinal:** increases secretion & motility.
 - Fibers to rectum:** cause defecation



5. Fibers to the lungs:

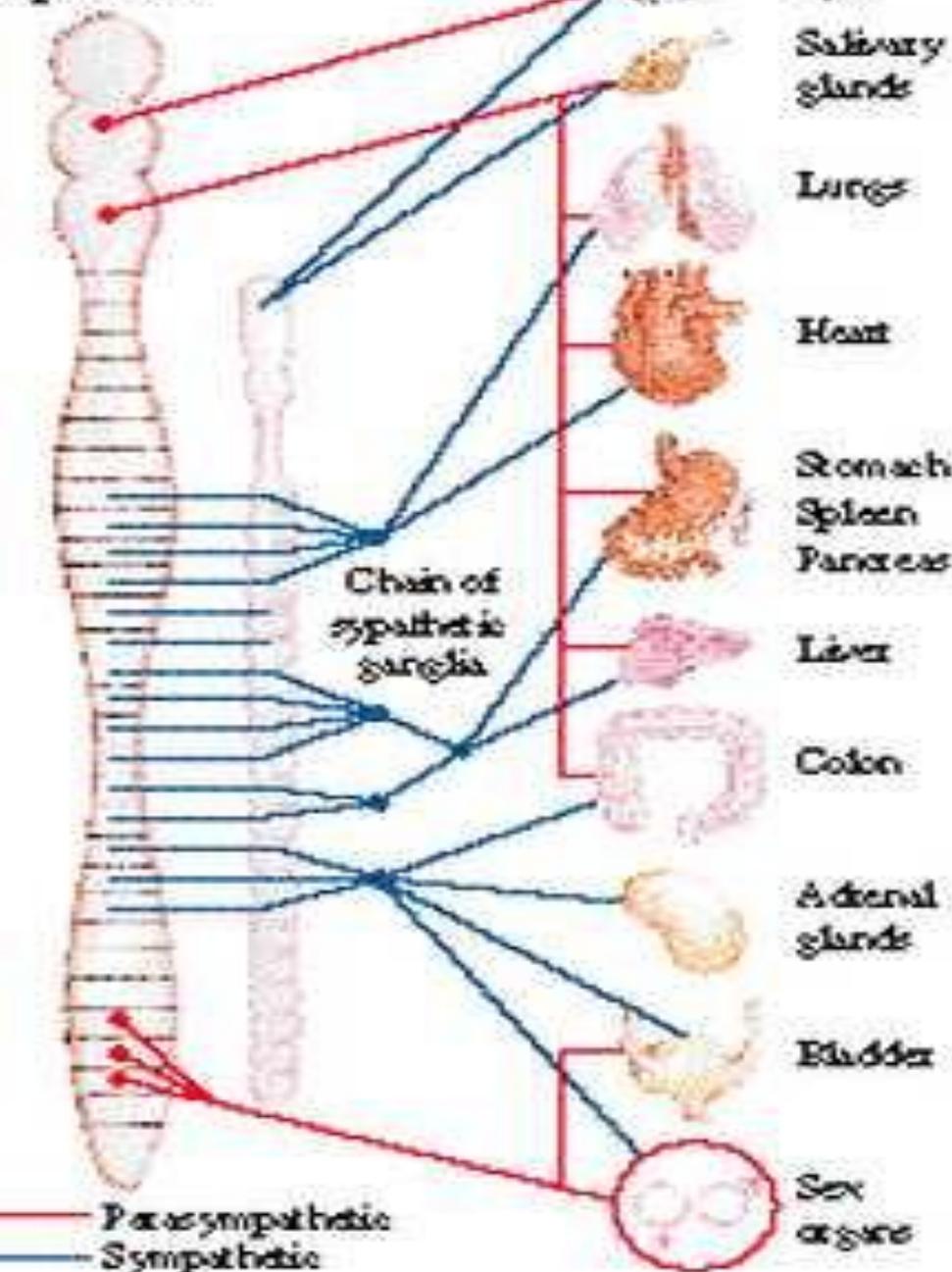
Smooth muscle contraction especially of airway cause state similar to asthma while removal of these fibers will cause dilation & relieving the attack.

6. Fibers to the heart: cause bradycardia, the fibers mainly to SA & AV nodes that will cause decrease conductivity of impulses. May cause heart block.

8. Fibers to the urinary bladder: causes urination.

9. Fibers to sexual organs: Penile erection
while ejaculation is sympathetic.

Brain and spinal cord



PARASYMPATHETIC SYSTEM

- Constriction of pupil
- Secretion of tear glands
- Salivation
- Inhibition of heart action
- Constriction of respiratory passages
- Stomach contraction; secretion of digestive fluids
- Intestinal peristalsis
- Contraction of bladder
- Erection

SYMPATHETIC SYSTEM

- Dilation of pupil
- Inhibition of tear glands
- Inhibition of salivation
- Acceleration of heart action
- Open respiratory passages
- Inhibits stomach contractions and digestive secretion
- Inhibits intestinal peristalsis
- Relaxes bladder
- Inhibits erection

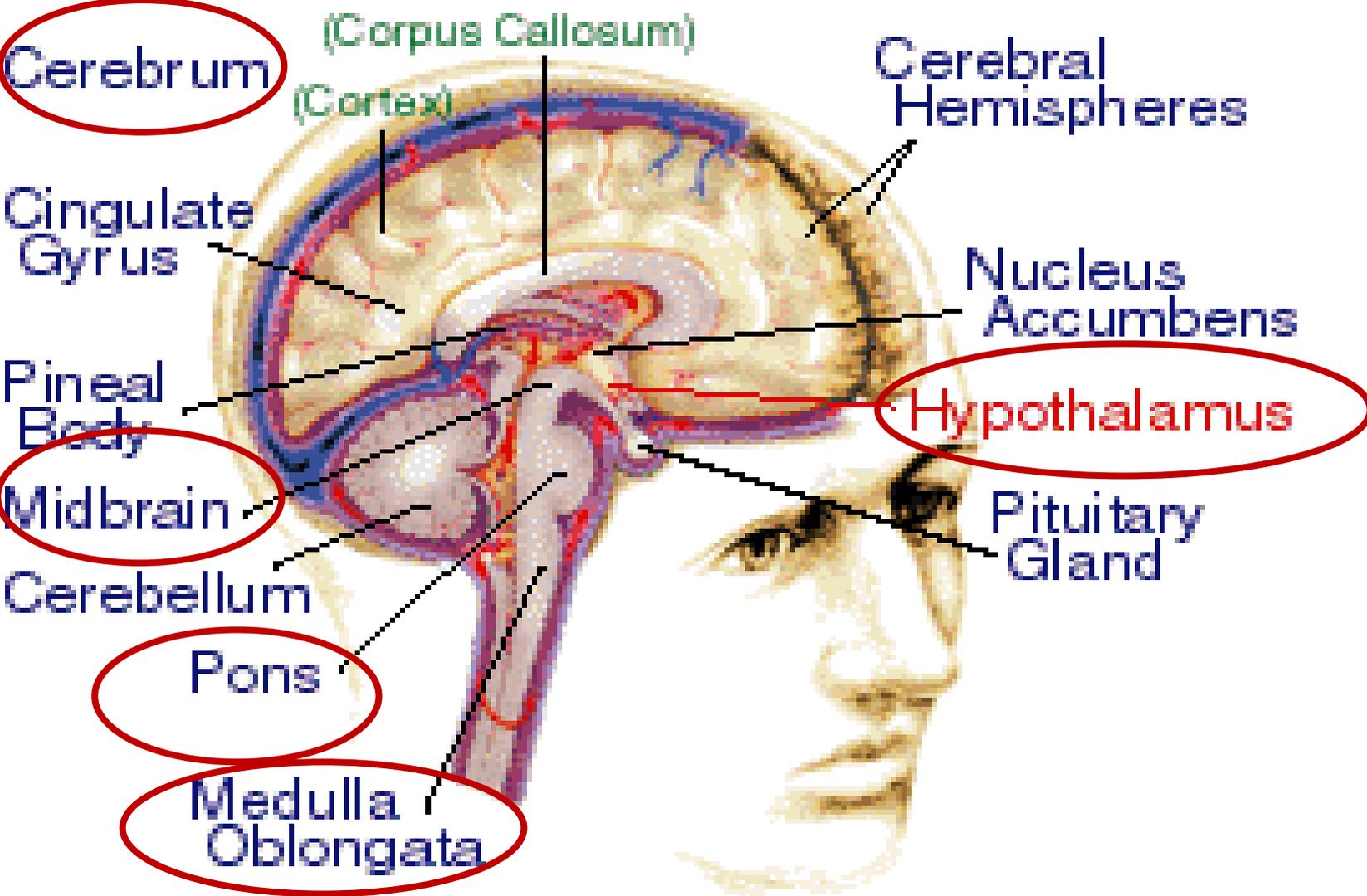
The higher center:



1. Cerebral cortex:-

2. Hypothalamus:-

3. Brain stem, Medulla oblongata, Midbrain:



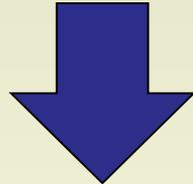
-At the center of it all-
The Hypothalamus:

Linking the Psyche (Mind) to the Soma (Body) and the Nervous System to the Endocrine System

1. Cerebral cortex:-

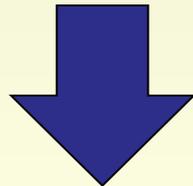


Areas of cerebral cortex



send impulses

**through the brain stem centers
or hypothalamus**



**modify the autonomic
activities according to the emotional factors.**

2. The Hypothalamus



It is formed of a large number of nuclei at the base of the brain adjacent to the 3rd ventricle.

- 1. Pre-optic.**
- 2. Supra-optic.**
- 3. Mammillary area.**
- 4. Para-ventricular area.**
- 5. Tuberal area.**

Hypothalamus:-



It is the main autonomic center in the body

Regulate most of body functions by

a) Direct effect:

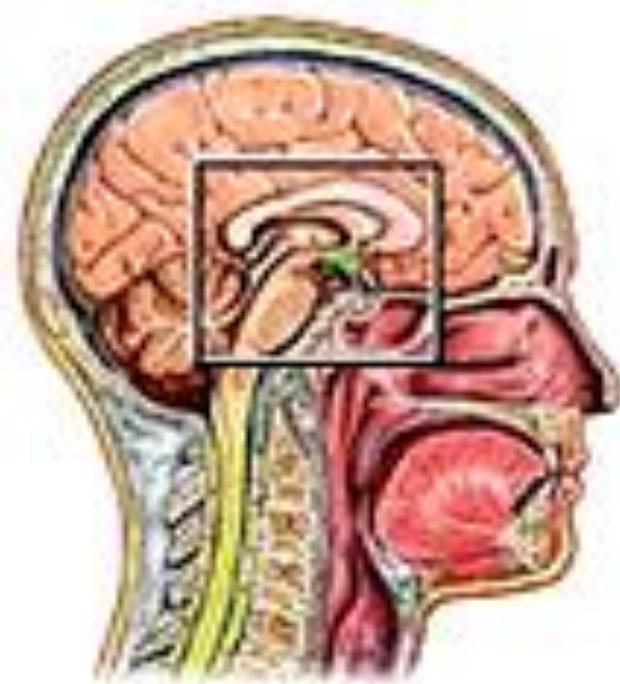
Through the different centers in the hypothalamus:

- Sleep center**
- Hunger (Appetite)**
- Thirst centers**

Through the sympathetic & parasympathetic fibers.

b) Indirect effect:

Through the pituitary gland & its hormones.



Hypothalamus

Midbrain

Pons



Pituitary gland



a. Direct effect:

Through a direct neural pathway from the hypothalamus down to the brain stem centers or spinal cord.

- * Appetite centers:**
- * Thirst center:**
- * Sleep center:**
- * Center for temperature**
- * Center for emotional regulation.**
- * Center for regulation of sexual activity:-**

Appetite centers:



It is formed of two centers:

1. Appetite center:

On stimulation it causes increase intake of food.

2. Satiety center:

Stimulation it causes decrease intake of food.

Both are controlled by blood sugar level.

Abnormality may cause:

- **Obesity**
- **Anorexia nervosa**

Sleep center



Reticular activating system:

Net work of nerve & cells that control sleep

Mechanism:

Open or close the pathway to the cerebral cortex

Nuclei that affect this control

Raphi nuclei

Locus cerulus

The neurotransmitters are :-

Nor adrenaline & Serotonine.

b. Indirect effect



Through hormonal control on the pituitary gland:

Hypothalamus secrete releasing factors that control secretion of the pituitary gland (master gland)

Anterior pituitary:-

Growth hormone (GH)

Thyroid stimulating hormone (TSH)

Adeno-corticotropic hormone (ACTH)

Follicular stimulating hormone (FSH)

Leutinizing hormone (LH)

Prolactin hormone

Posterior Pituitary:-

Oxytocin: from supra-optic and Para ventricular nuclei

Ant-diuretic hormone (ADH)

Diabetes insipidus:-



Congenital disease

characterized by deficiency of ADH that

Polyurea: ↑ urination

Polydipsia: ↑ intake of water

**The urine is of low specific gravity
goes down to 1010 or even less.**

3. Brain stem, Medulla oblongata, & the Midbrain:



a. Vital centers:

Respiratory, cardio-vascular , Vasomotor centers.

They send impulses to the chief preganglionic nerve fibers in spinal cord or cranial nerves or through the cerebral cortex and hypothalamus.

b. Reflexes:

Swallowing, vomiting, coughing, sneezing, others. that act reflexely due to receptor stimulation.

One of these nuclei is the nucleus of tractus solitarous that regulate the secretion of the salivary gland.