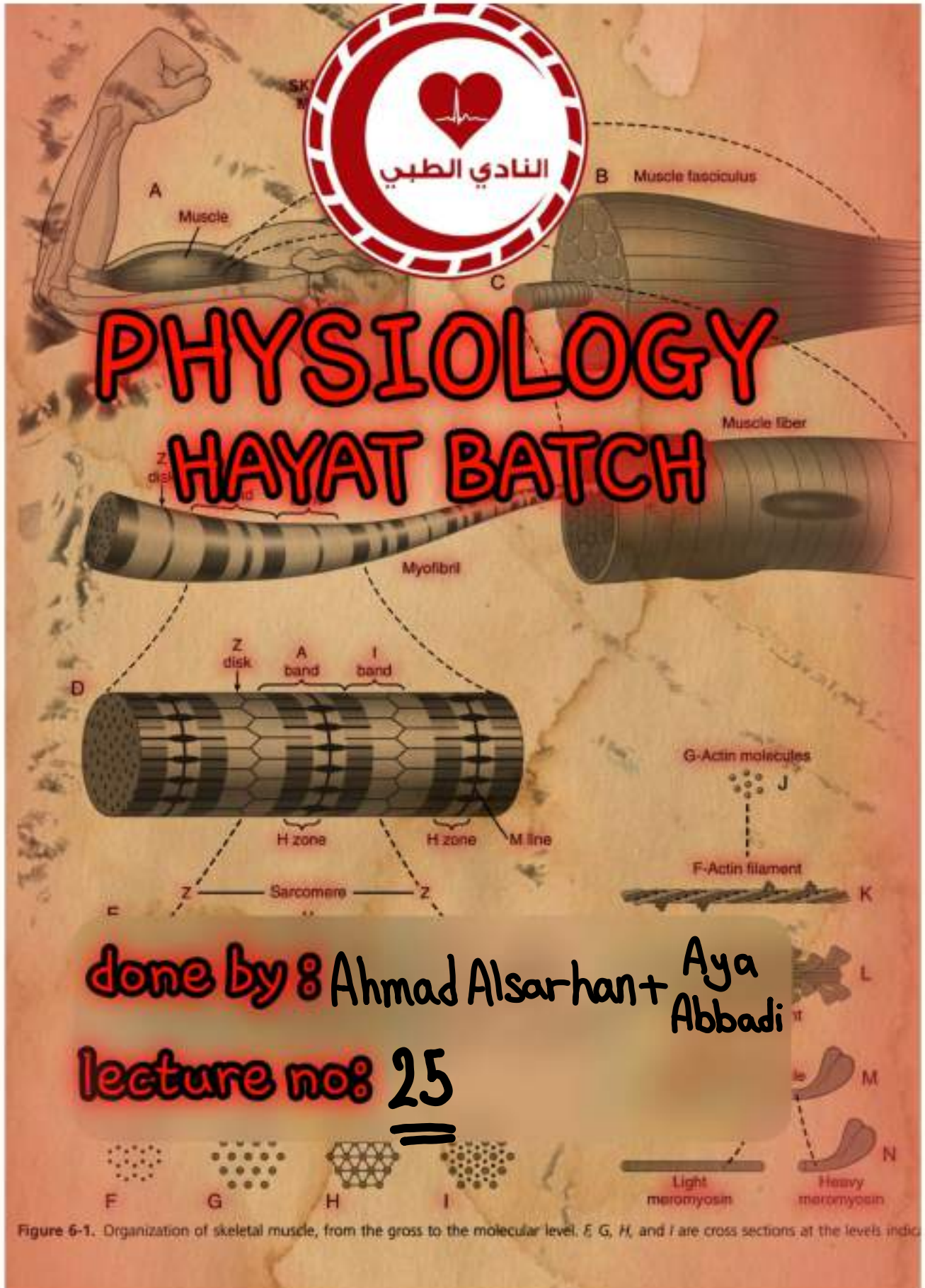




# PHYSIOLOGY HAYAT BATCH



done by : Ahmad Alsarhan + Aya Abbadi

lecture no: 25

Figure 6-1. Organization of skeletal muscle, from the gross to the molecular level. E, G, H, and I are cross sections at the levels indicated.

**General Physiology**  
**Second semester 2023**  
**Lectures25**  
**Functions of Adrenal Medulla**  
**Autonomic Reflexes**  
**Central Regulation of Autonomic Reflexes**

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## Lecture Objectives

- Describe the sympathetic innervation to adrenal medulla
- Identify the hormones released by adrenal medulla and their functions.
- Understand the sympathetic and parasympathetic tone.
- Identify central nervous system areas which influence the activity of autonomic nervous
- Briefly Identify the autonomic reflexes and list examples of these reflexes
- Describe the stress and alarm response of the sympathetic nervous system.

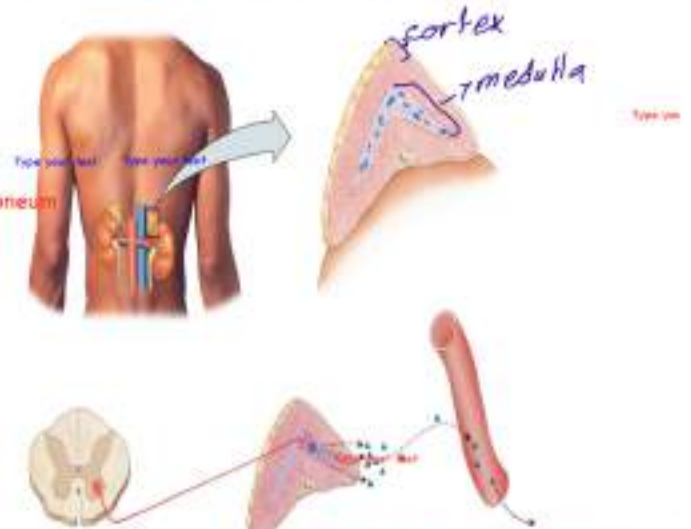


# Functional anatomy of adrenal medulla

Two adrenal glands in the body and each gland is in close association with a kidney.

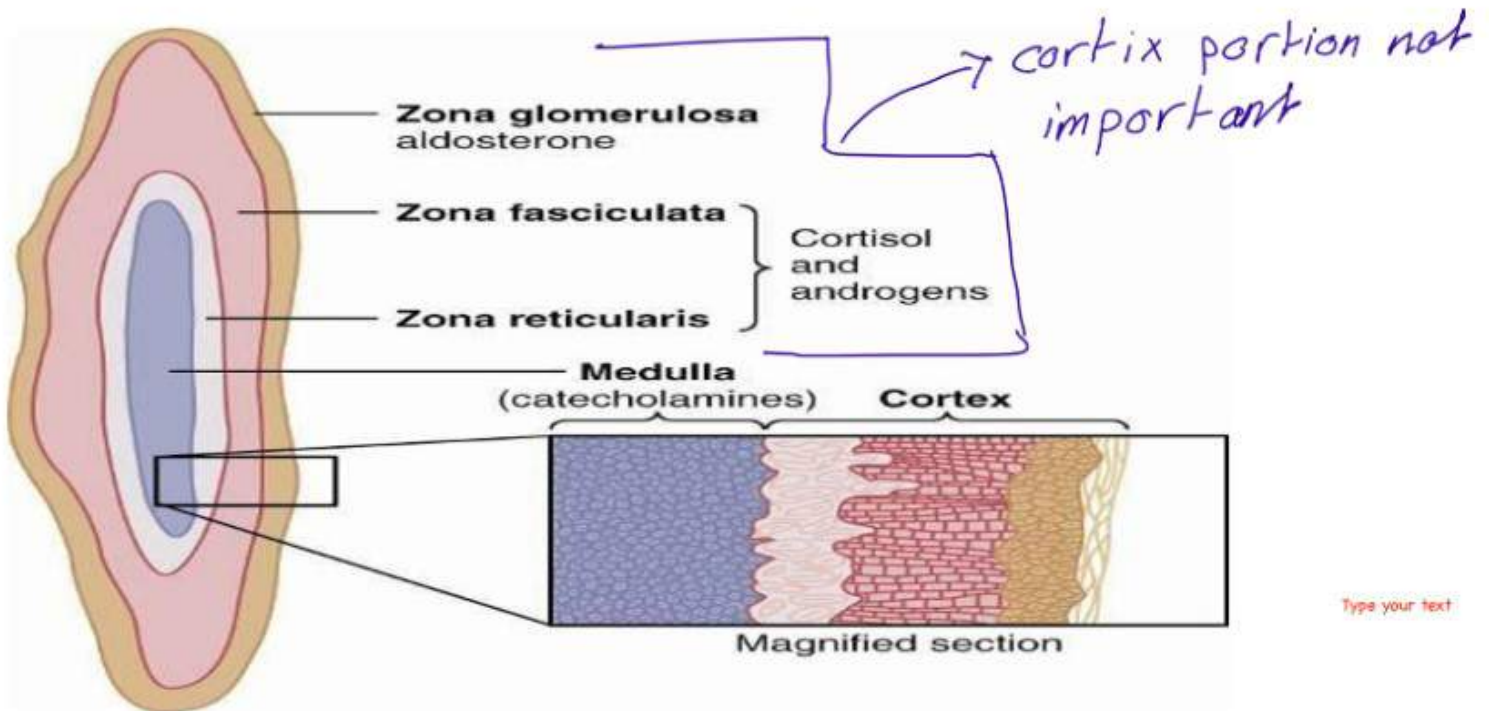
The adrenal glands are:

- **Retroperitoneal** structures *Mean that is outside the peritoneum*
- Located on the superomedial aspect of each kidney
- Separated from the **kidneys** by a **fibrous** tissue
- Composed of
  - Adrenal medulla (the central 20%)
  - Adrenal cortex (80% of the gland).



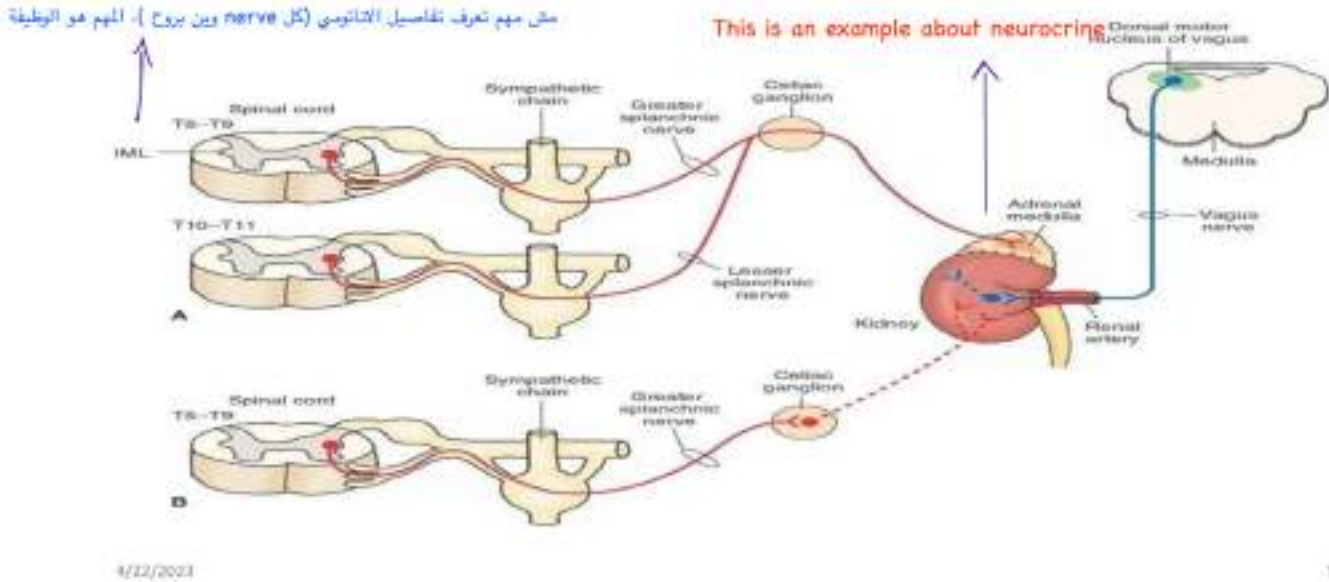
ما هي postsynaps ليس تتلقى الإشارة يتم الإفراز .  
يعتقد ان ال adrenal medulla نشأت من ال neural tissue . وليس بما أصبحت  
neurotransmitters بل تفرز its content مباشرة لعدم وجود postsynaptic

4/22/2023



Type your text

## Suprarenal Gland Innervation by Sympathetic Nerves



## Hormones of adrenal medulla

- Functionally related to the sympathetic nervous system. It is derived from a subpopulation of neural crest cells.
  - It synthesizes and secretes epinephrine, norepinephrine, and dopamine in response to direct sympathetic stimulation.
  - Secretes
    - Epinephrine
    - Norepinephrine
    - Dopamine
- } → Catecholamines hormones
- Epinephrine, Norepinephrine: have almost the same effects as direct stimulation of the sympathetic nervous system
  - Dopamine function is not exactly know



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## Release of adrenal medulla hormones and their time course of action

- Stimulation of the sympathetic nerves to the adrenal medullae causes release of large quantities of the hormones epinephrine (E) and norepinephrine (NE) into the circulating blood.
- 80% of the secretion is epinephrine and 20% is norepinephrine, although the relative proportions **can change** considerably under different physiological conditions.
- The circulating E and NE have almost the same effects on the different organs as the effects caused by direct sympathetic stimulation, except that the effects last 5 to 10 times as long because both hormones are removed from the blood slowly over a period of 2 to 4 minutes.

They have long duration (in minute) because they are hormone

$\beta_2$  receptors  $\rightarrow$  E /  $\alpha$  receptors  $\rightarrow$  NE

الاختلاف الوحيد بين (NE/N) هو ال  $\alpha$  receptor. N affinity .

## Epinephrine and Norepinephrine responses

- Epinephrine causes almost the same effects as those caused by norepinephrine.
- Epinephrine Has a greater effect on cardiac stimulation than does norepinephrine.
- Epinephrine causes only weak constriction of the blood vessels in the muscles, in comparison with much stronger constriction caused by norepinephrine.
- The effects of Epinephrine on metabolism is 5 to 10 times as great as norepinephrine.
- Example of metabolic effects  $\rightarrow$   $\beta$  receptors  
glycogenolysis in the liver and muscle  
glucose release into the blood.

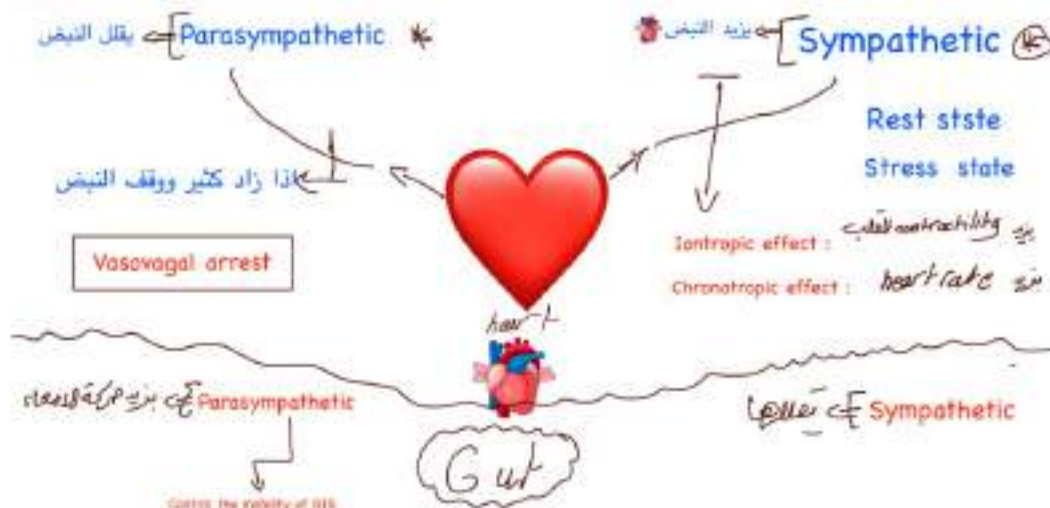
## Advantage of Adrenal Medullary Secretion

- The simultaneous organ stimulation directly by sympathetic nerves and indirect by the adrenal medullary hormones support each other (synergistic effect)
- Adrenal medullary epinephrine and norepinephrine stimulates structures of the body that are not innervated by direct sympathetic fibers

\* إذا بقيت مناطق معينة مشغولة وأصلها ال sympathetic nervous system فإن إفراز ال (N/ NE) يعوض هذه المناطق

## Sympathetic and Parasympathetic Tone

- Normally, the sympathetic and parasympathetic systems are **continually active**, and the basal rates of activity are known, respectively, as **sympathetic tone and parasympathetic tone**.
- The increase or decrease in the tone can increase or decrease in the activity of the stimulated organ.
- Example
- Increase sympathetic tone can cause vasoconstriction and decrease of sympathetic tone vasodilation of arterioles
- Gastric motility is affected by change in parasympathetic tone
- Heart rate is increased or decrease by changing parasympathetic tone .
- Under different physiological conditions , the activity of one autonomic nervous system subdivision can dominate the other.
- For example : the sympathetic system dominates during stress response, while, parasympathetic system dominates in quiet and restful circumstances (Rest and digest).
- Sympathetic tone Caused by Basal Secretion of Epinephrine : much of the overall tone of the sympathetic nervous system results from basal secretion of epinephrine and norepinephrine in addition to the tone resulting from direct sympathetic stimulation
- Removal of the sympathetic or parasympathetic tone by denervation results in **denervation supersensitivity**. This mechanism is believed to be due to up-regulation of the adrenergic or cholinergic receptors





## Local Vs. Mass Stimulation of the Sympathetic and Parasympathetic Systems

- **Mass discharge of sympathetic nervous system wide spread activity in all parts of the SNS**
- The result is a widespread reaction throughout the body called the **alarm or stress response**
- Localized activation occurs in isolated portions of the sympathetic nervous system. Important examples are:
  1. Thermoregulation : control of sweating and vascular blood flow in the skin.
  2. Gastrointestinal reflexes. Gastric sensory receptor stimulation → reflex arc through paravertebral ganglia → back to the gut through sympathetic nerves to control motor or secretory activity.
- The parasympathetic system usually causes specific localized responses. Example is the salivation in the mouth upon stimulation of touch receptors. However, there is often **association** between closely allied parasympathetic functions. Example; urinary bladder and rectal emptying reflexes

ال sympathetic بالعامة  
يتنشر لكنها قد تكون  
local في أماكن معينة

Massive increase or massive discharge in the activity of the adrenal medulla

## The Alarm or Stress Response of the Sympathetic Nervous System

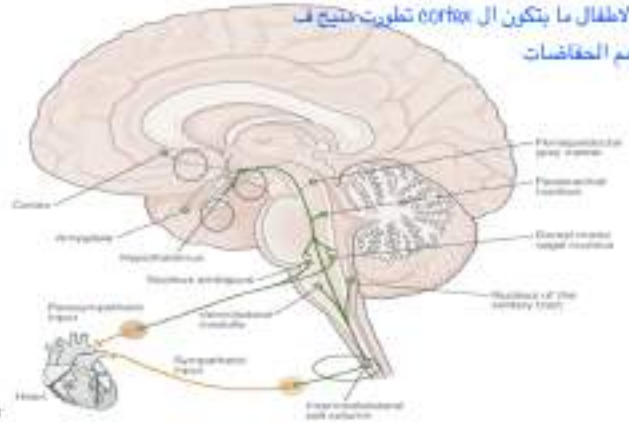
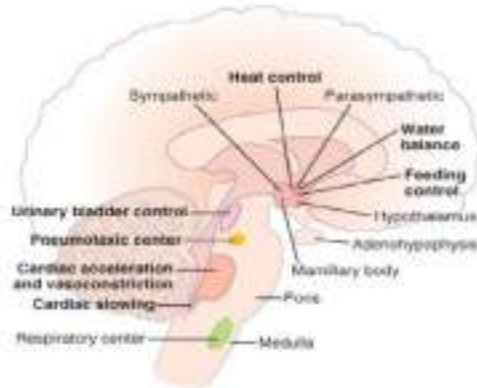
- The stress response increases the ability of the body to perform vigorous muscle activity in many ways, including:
  1. Increased arterial pressure.
  2. Increased blood flow to active muscles concurrent with decreased blood flow to organs such as the gastrointestinal tract and the kidneys that are not needed for rapid motor activity.
  3. Increased rates of cellular metabolism throughout the body.
  4. Increased blood glucose concentration.
  5. Increased glycolysis in the liver and in muscle.
  6. Increased muscle strength.
  7. Increased mental activity.
  8. Increased rate of blood coagulation.
- The sympathetic system is especially strongly activated in many emotional states. For instance, in the state of **rage**.
- The sympathetic alarm reaction is also called the **fight-or-flight reaction**.



## Higher central nervous system Pathways that control autonomic responses

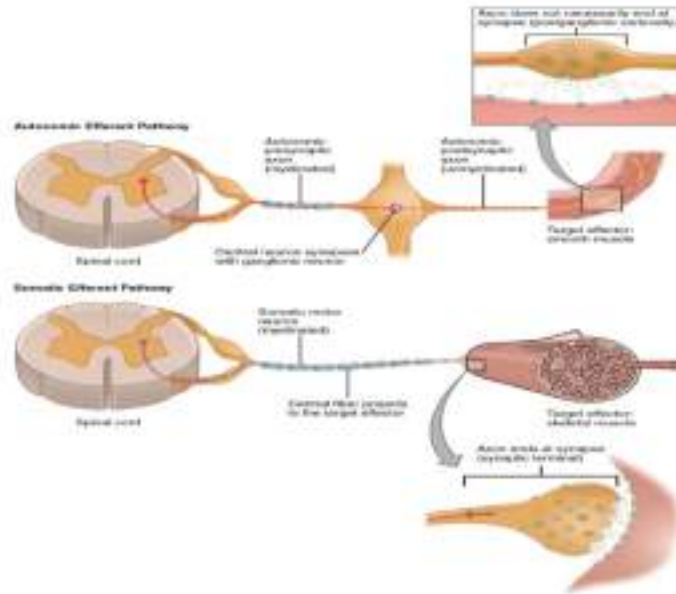
جزء منها موجود في ال cerebral cortex لكن معظمها في ال hypothalamus

بعض ال reflex يتم التحكم فيها وتعديلها في ال cortex  
انفريوس ال full when the bladder is مياشرة reflex  
لحتى يفضيها بس انت بتقدر تملك خالك لانه ال cortex  
بيأخر هاد ال reflex  
اما بالاطفال ما يتكون ال cortex تطورت حتى ف  
بليسوهم الحفاضات



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## Autonomic vs Somatic Reflexes



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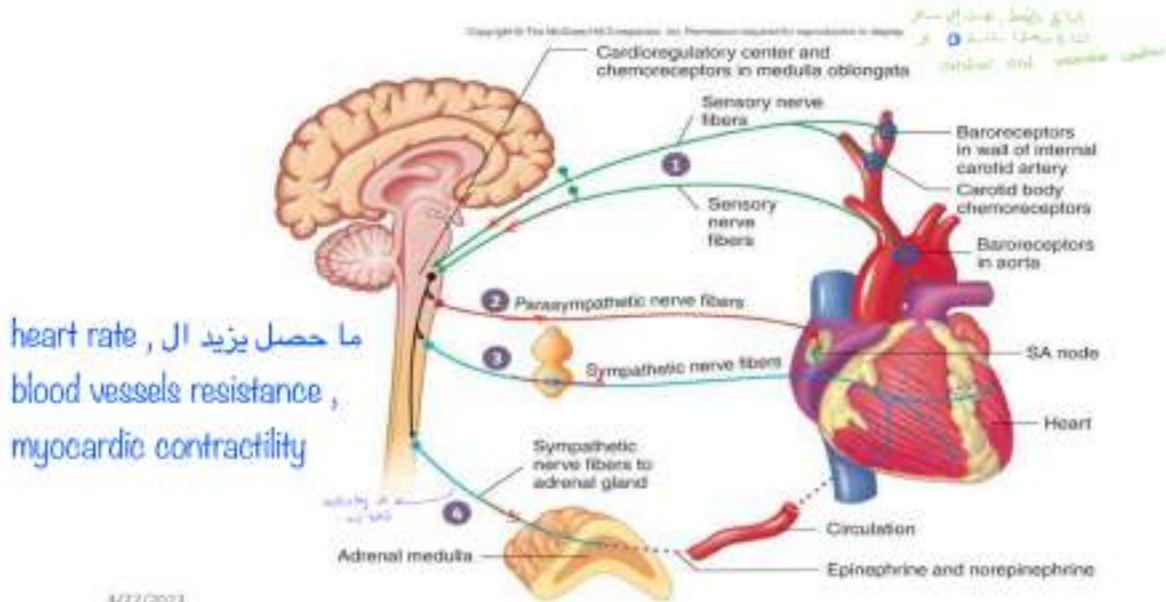
## Autonomic reflexes

- Cardiovascular Autonomic Reflexes.
- Gastrointestinal Autonomic Reflexes Defecation reflex
- Pupil reflex
- Micturition reflex : Emptying of the urinary bladder
- Sexual reflexes



مركز تنظيم ضغط الدم

## Baroreceptor autonomic reflex



## Disturbances Related to Autonomic Involvement

الدكتور حكا ما بدني تعرفوهم بس حطيتهم عشان افرجيكم انه كل جهاز في اله مشاكله

- 1- Horner's syndrome:
  - Is a unilateral enophthalmos, ptosis, miosis, and flushing of the face often caused by an ipsilateral involvement of the sympathetic fibers in the cervical sympathetic chain or upper thoracic cord.
- 2- Hirschsprung's disease (megacolon):
  - Consists of a tremendous dilatation of the colon, with chronic constipation. It is associated with congenital lack of parasympathetic ganglia and the existence of abnormal fibrils in the apparently normal segment of large bowel wall
- 3. Dysautonomia
  - Autonomic failure
  - [Autonomic neuropathy](#)