Pharmacology of Autonomic Nervous System (1)

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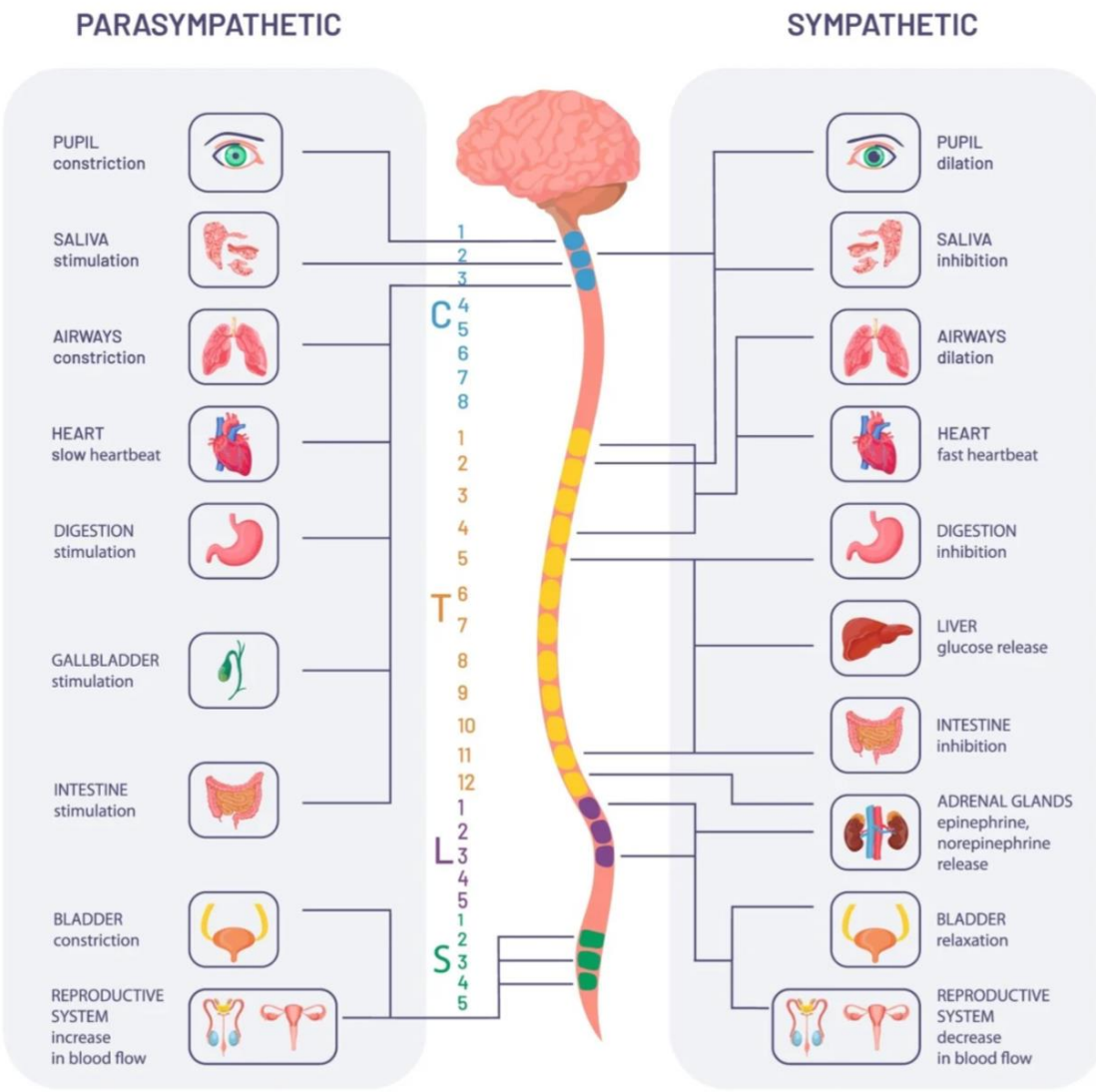
The function of ANS :

The ANS has three major divisions: the sympathetic nervous system, the parasympathetic nervous system, the enteric nervous system.

The enteric nervous system is intrinsic to the wall of the GI tract works with the parasympathetic and sympathetic nervous systems to control digestion.

It influences the function of nearly every organ in the body.

It controls all innervated organs and tissues except skeletal muscles.

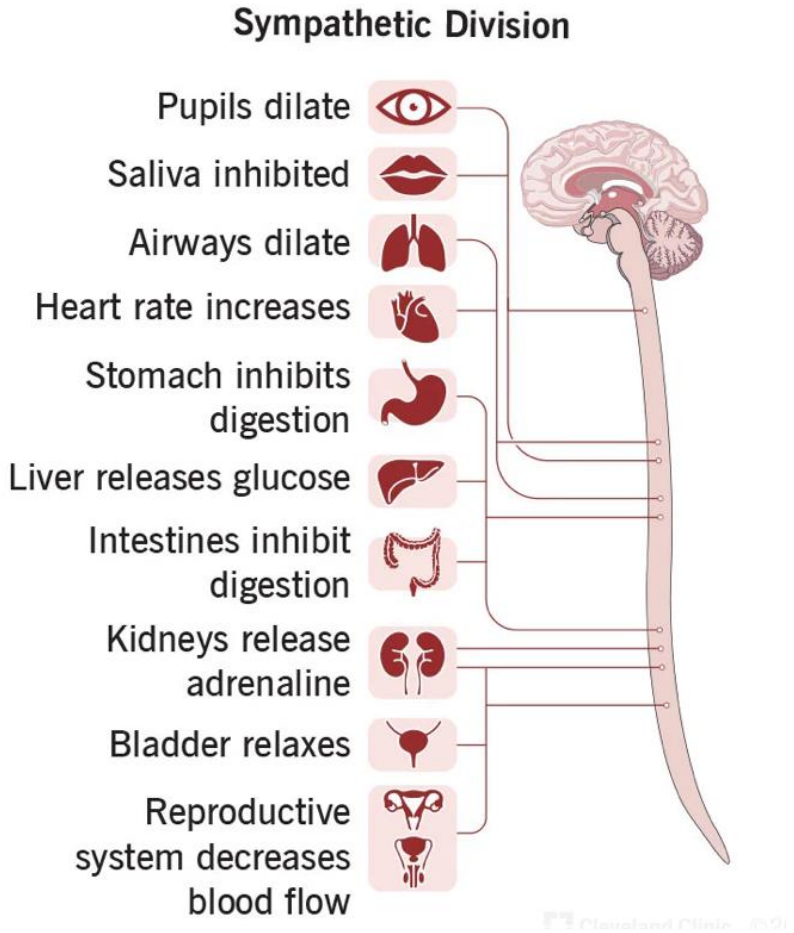


The ANS

The ANS is tightly linked with many behaviors, emotions, and the immune system.

Some common examples including: during exercise altering cardiorespiratory responses, when attempting to escape from a threatening environment, when facing a fearful situation, during an inflammatory response, when simply moving from a supine to an upright posture.

To meet the metabolic and thermoregulatory demands of different situations, the ANS automatically makes adjustments in regional blood flow and cardiac output, It integrates with the central respiratory network.



The ANS

It carries out its functions without requiring a conscious effort, so it is sometimes referred to as the involuntary nervous system.

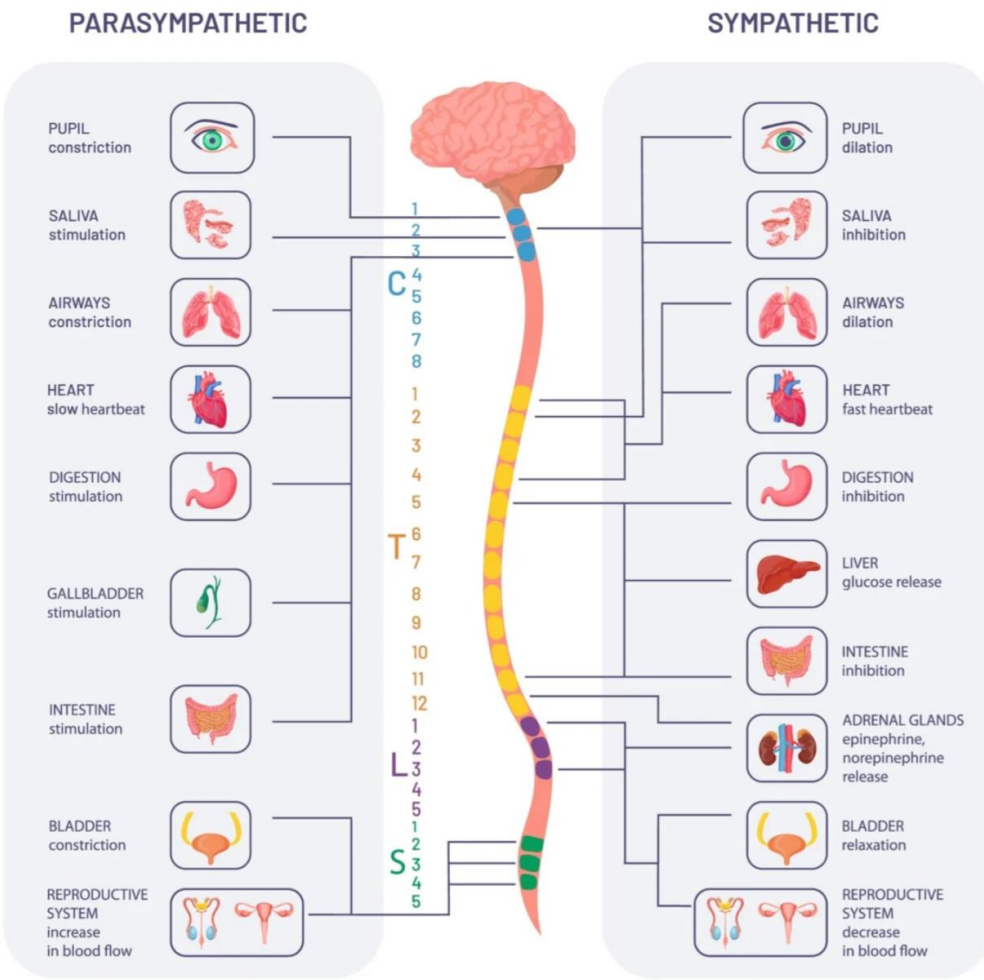
Its ultimate responsibility is to ensure the physiological integrity of cells, tissues, and organs throughout the entire body, homeostasis is maintained despite perturbations exerted by both the external and internal environments.

The two anatomically and functionally distinct divisions of the ANS are the sympathetic nervous system and parasympathetic nervous system.

They can function antagonistically, synergistically, or independently to control their many autonomic effector organs.

Some autonomic effector organs (e.g., heart, bronchi, stomach, and urinary bladder) are innervated by both the sympathetic and parasympathetic nervous systems; and the two divisions function as physiological antagonists.

In other cases (e.g., iris muscles in the eye and sexual organs) the two divisions of the ANS function synergistically to control a function.



The ANS

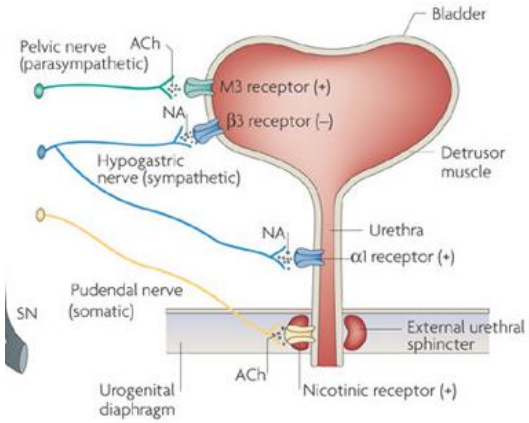
Neuroendocrine physiology is closely linked to autonomic regulation.

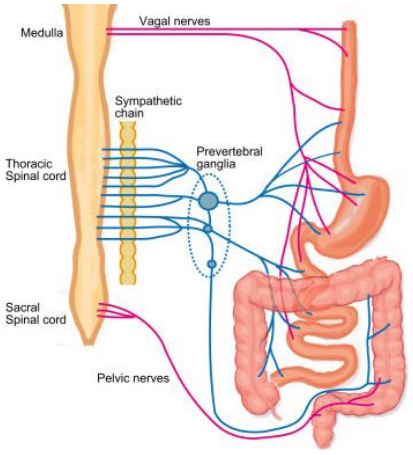
Some autonomic functions:

Excretion from the urinary tract and GI tract rely on both the autonomic (involuntary) and somatic (voluntary) nervous systems for normal physiological behavior.

Although survival might be possible without the sympathetic nervous system, the ability to adapt to environmental stressors is severely compromised by autonomic failure.

Without an intact parasympathetic nervous system, survival is problematic as one could lose the ability to eliminate wastes and toxins from the body.





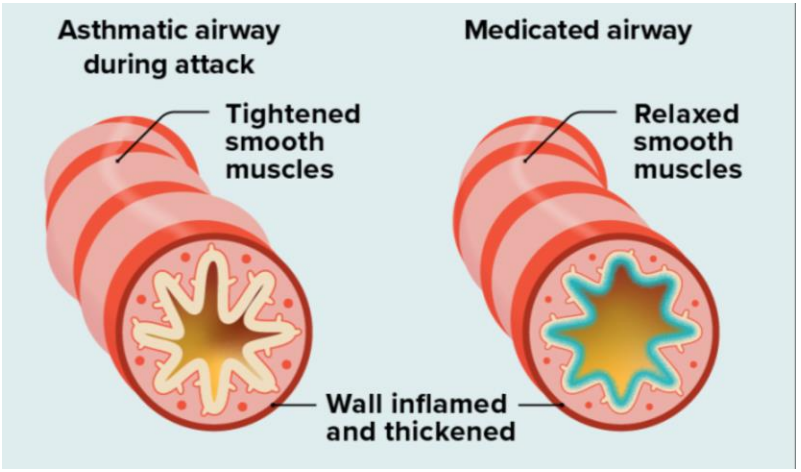
Clinical applications on ANS drugs

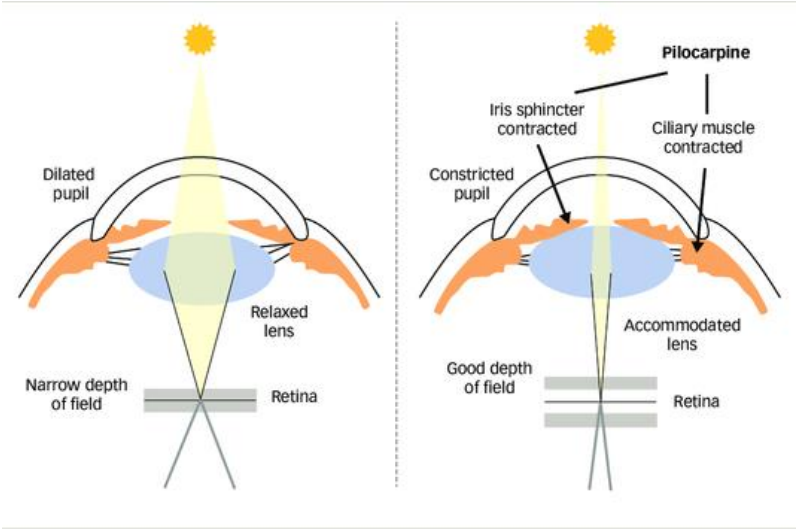
Many commonly prescribed drugs, over-the-counter drugs, or toxins and toxicants function by altering adrenergic or cholinergic neurotransmission within the ANS.

Exerting an action downstream on autonomic target organs and tissues or on non autonomic effector targets.

β-adrenoceptor agonists are frequent choices for treatment of asthma.

Many β-adrenoceptor antagonists are used in the treatment of: a wide range of cardiovascular disorders, glaucoma, essential tremor, anxiety disorders.



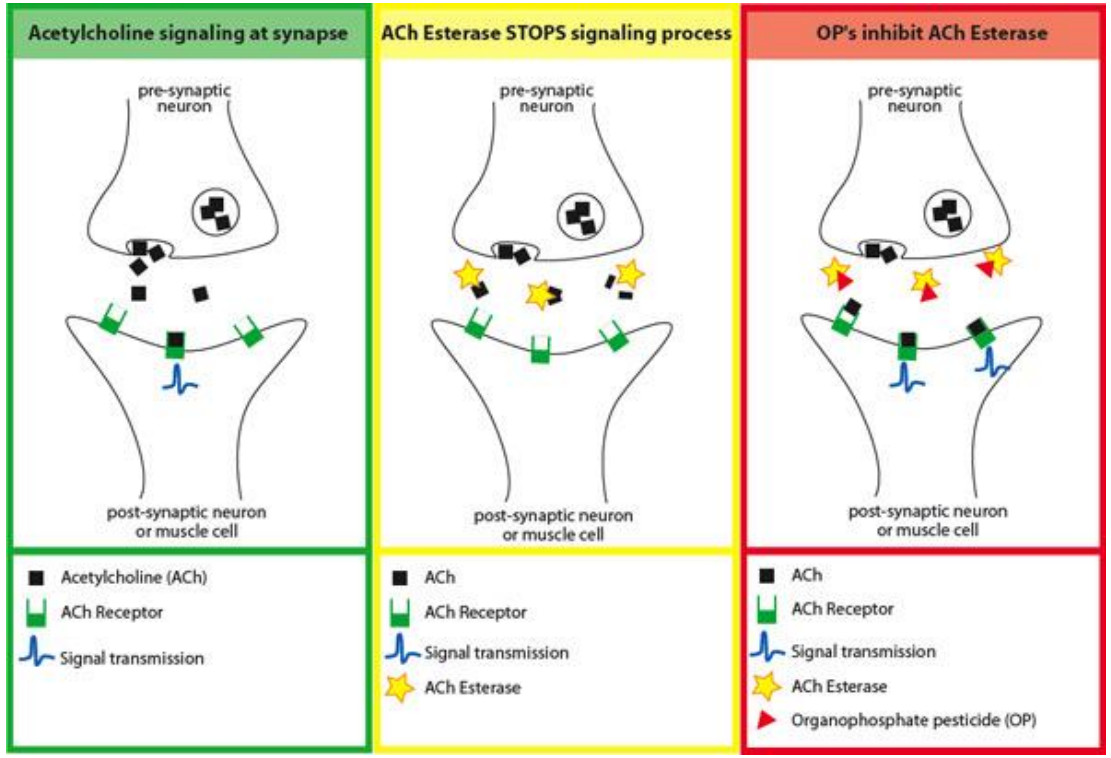


Clinical applications on ANS drugs

Some drugs have specific autonomic target organs such as drugs used to treat erectile dysfunction.

Toxins like nerve gas (an organophosphate) interfere with cholinergic transmission not only at the neuromuscular junction but also on autonomic effector organs.

Some naturally occurring products mimic the action of autonomic neurotransmitters including: Muscarine from Amanita muscaria Pilocarpine from the rutaceae plant family, Atropine or Hyoscine from the solanaceae plant family.



Sympathetic VS. Parasympathetic

Sympathetic activation during intense emotions is that all elements of the sympathetic nervous system typically work in union, that is, an "all-or-none" response.

The sympathetic nervous system is often defined as being the "fight or flight" division of the ANS. A mass activation of the sympathetic nervous system during various emotions (fear, rage, and pain).

The major role of sympathetic nervous system was to allow individuals to respond to danger, threats, and stress.

The parasympathetic nervous system is often referred to as the "rest and digest" system in recognition of its role in conserving energy, promoting digestion, and ridding the body of wastes.

SYMPATHETIC NERVOUS SYSTEM

Stress Response

Revs you up, preparing you to fight, take flight or freeze

- Heart beats fast
- Breath is fast and shallow
- Pupils of eyes expand (can make you sensitive to light)
- Gut becomes inactive (difficult to digest)
- Blood rushes to your skeletal muscles and away from your brain, making it hard to think clearly
- Hormones rush through your body, making you feel anxious
- Expends your energy

PARASYMPATHETIC NERVOUS SYSTEM

Relaxation Response

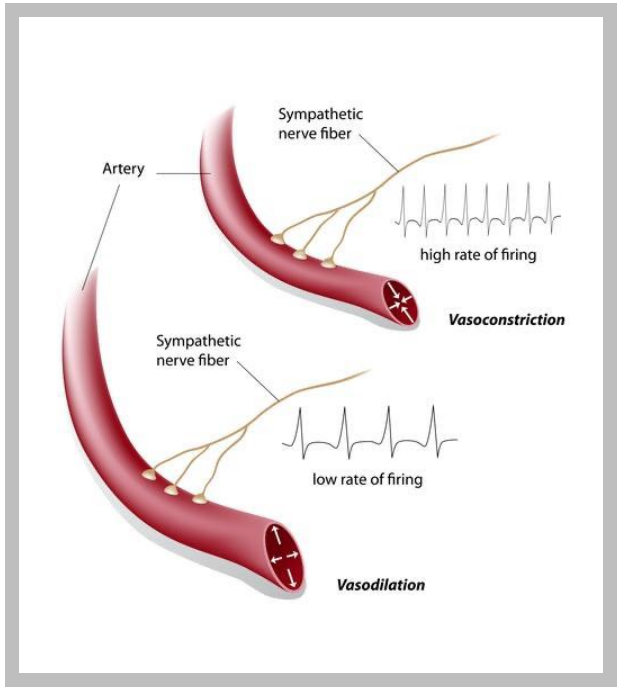
Calms you down, preparing you to rest, think and restore

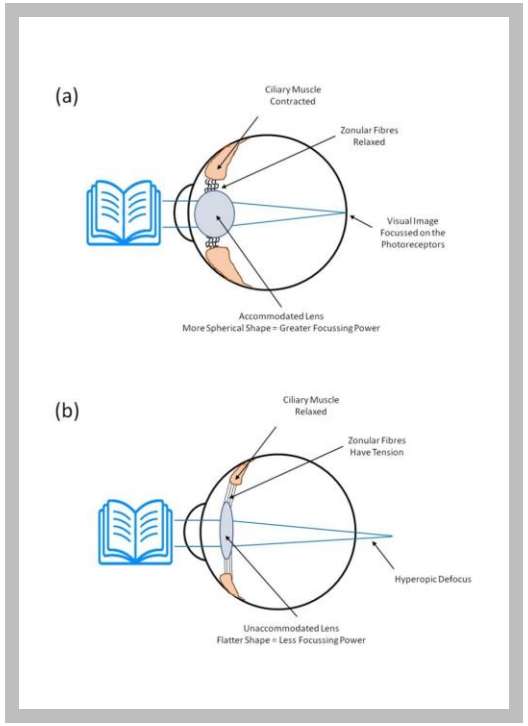
- Heart beats in slow, rhythmic pattern
- Breath is full and slow
- Pupils of the eyes shrink
- Gut is active (helps you digest and absorb the nutrients from your food)
- Increased blood flow to gut, lungs and brain
- Hormones rush in, lifting your mood and helping you to relax
- Conserves your energy

Physiological Actions of Sympathetic and Parasympathetic Outflow

Antagonistic, Synergistic, and Independent Control of Target Organs.

Other organs are innervated by only the sympathetic nervous system (e.g., blood vessels, brown adipose tissue, and pineal gland) or by only the parasympathetic nervous system (e.g., ciliary muscle and nasopharyngeal glands).





α and γ-motor neurons

Both α-motor neurons and γ-motor neurons have a singular action: contraction of the extrafusal (α-motor neurons) and intrafusal (γ-motor neurons) fibers within skeletal muscle.

They are often co-activated, work in synchrony to mediate skeletal muscle contraction with the goal of allowing for gross fine motor control to maintain posture and balance and to permit locomotion, eye movements, vocalization, and swallowing.