

**Sympathetic and
parasympathetic nervous
systems. Autonomic
innervation and reflexes of
pelvic organs**

János Hanics M.D.

Vegetative (autonomic) nervous system

General function: to keep the homeostasis of the body.

Fast reactions to inner and outer stimuli independently from will (=autonomic: cardiovascular regulation, alimentary functions etc...). The structural basis is the vegetative **reflex arc**.

- The impulses of visceral receptors convey to the **central nervous system**, where they can integrate in different levels.

- The efferent pathways of the vegetative system regulate different organ systems.

-Two main parts:

A. **Sympathetic** nervous system.

B. **Parasympathetic** nervous system.

Generally they cause opposite effects, which normally complete each other – create homeostasis. Differentiation based on their:

- 1) anatomy,
- 2) neurotransmitters,
- 3) effect on organs.

Vegetative nervous system

Has a central and peripheral part.

Central part:

1. Hypothalamus

2. Vegetative centers of the brainstem:

- respiratory and vasomotor center of the brainstem
- periaqueductal grey matter of the midbrain
- the visceromotor and viscerosensory nuclei of cranial nerves

3. Spinal cord level (intermediolateral cell column)

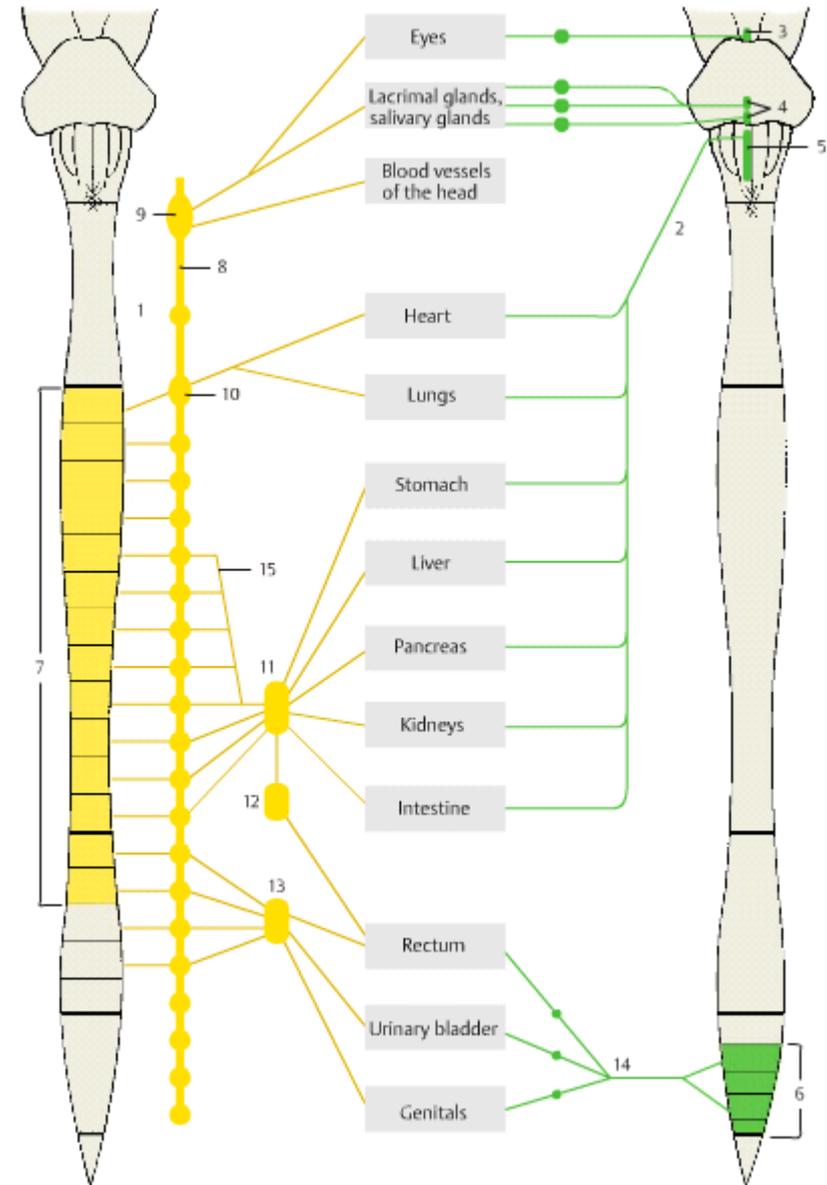
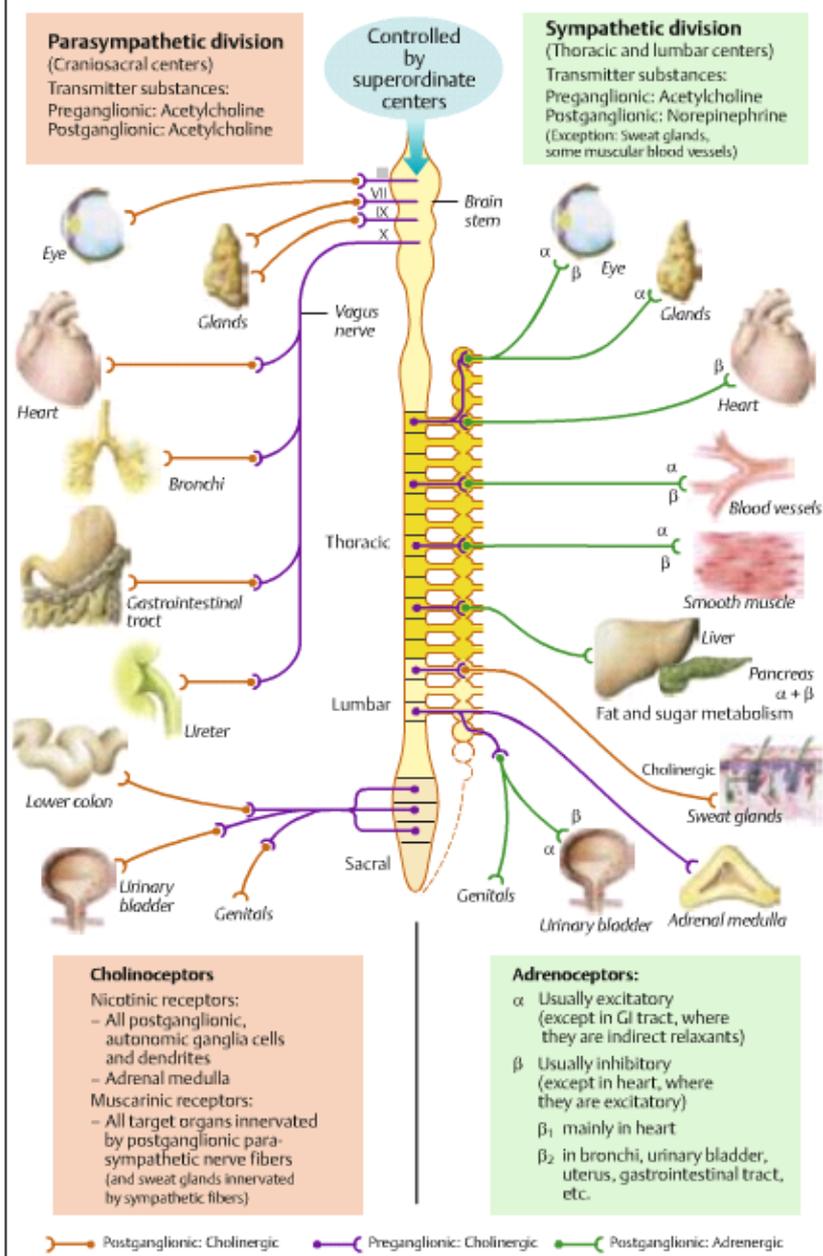
DLF – dorsal longitudinal fasciculus (of Schütz) – band of ascending and descending pathways which connect central vegetative centers.

Peripheral part:

- | | |
|--|-----------------|
| 1. cranial outflow (CN. III; VII; IX; X) | parasympathetic |
| 2. thoracolumbar outflow (T1-L3) | sympathetic |
| 3. sacral outflow (S2-S4) | parasympathetic |

Vegetative efferents

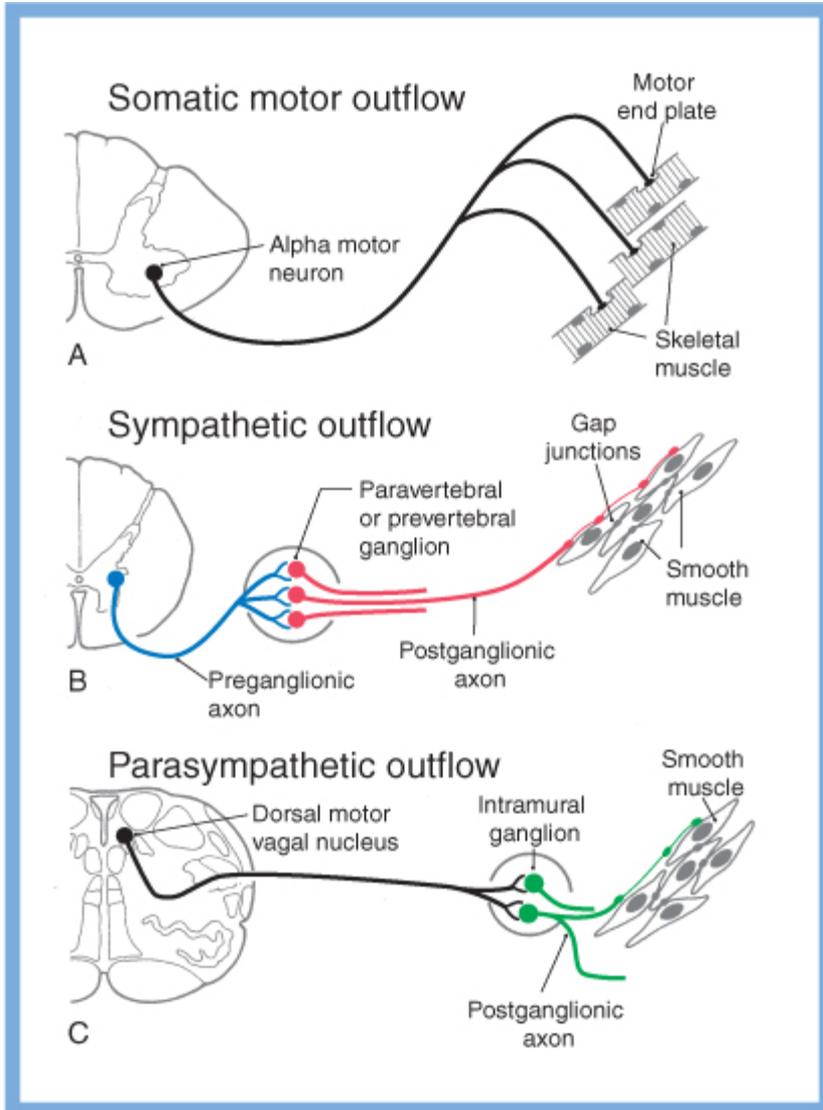
A. Schematic view of autonomic nervous system (ANS)



A Sympathetic and parasympathetic nervous systems (adapted from Villiger and Ludwig)

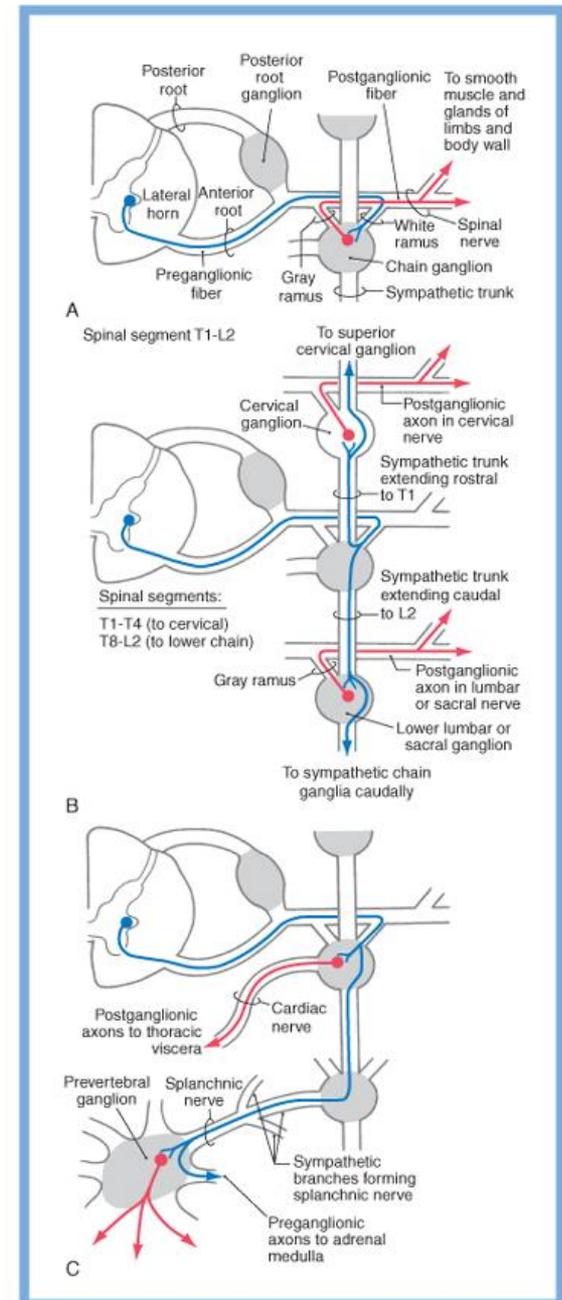
Para – and praevertebral ganglia

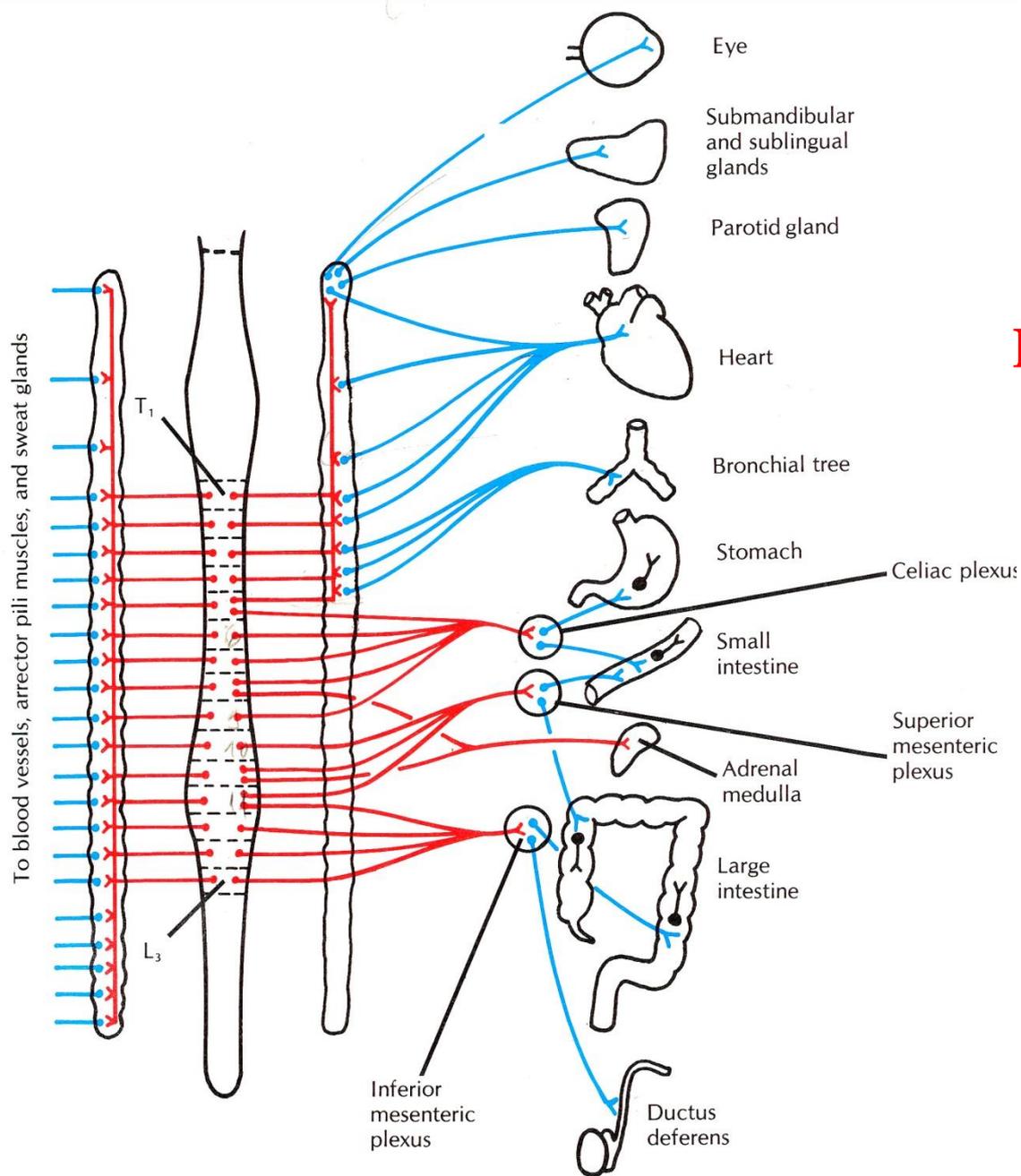
Intramural ganglia



EFFERENTS

Always in „two step”





Parts of the sympathetic nervous system

Cephalic and cervical parts

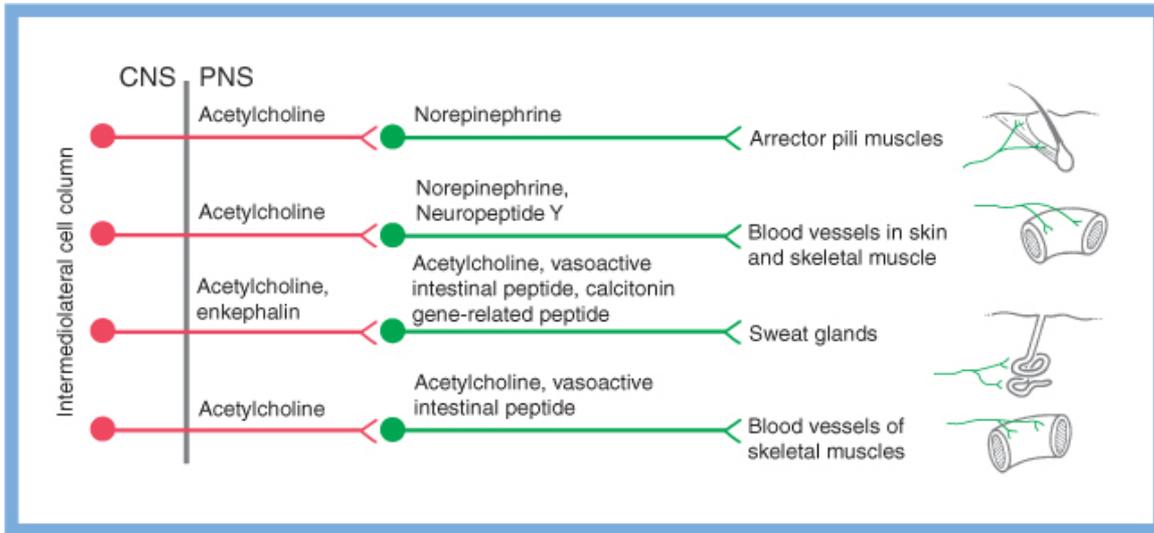
Thoracic part

Abdominal part

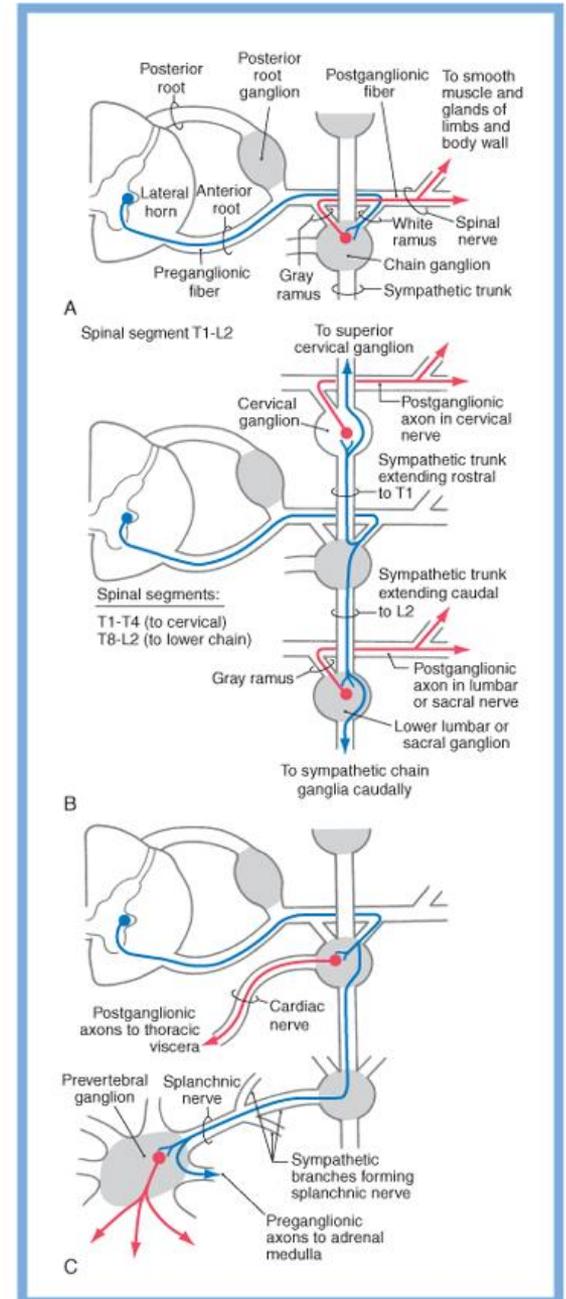
Pelvic part

FIGURE 24-4.
The sympathetic nervous system.

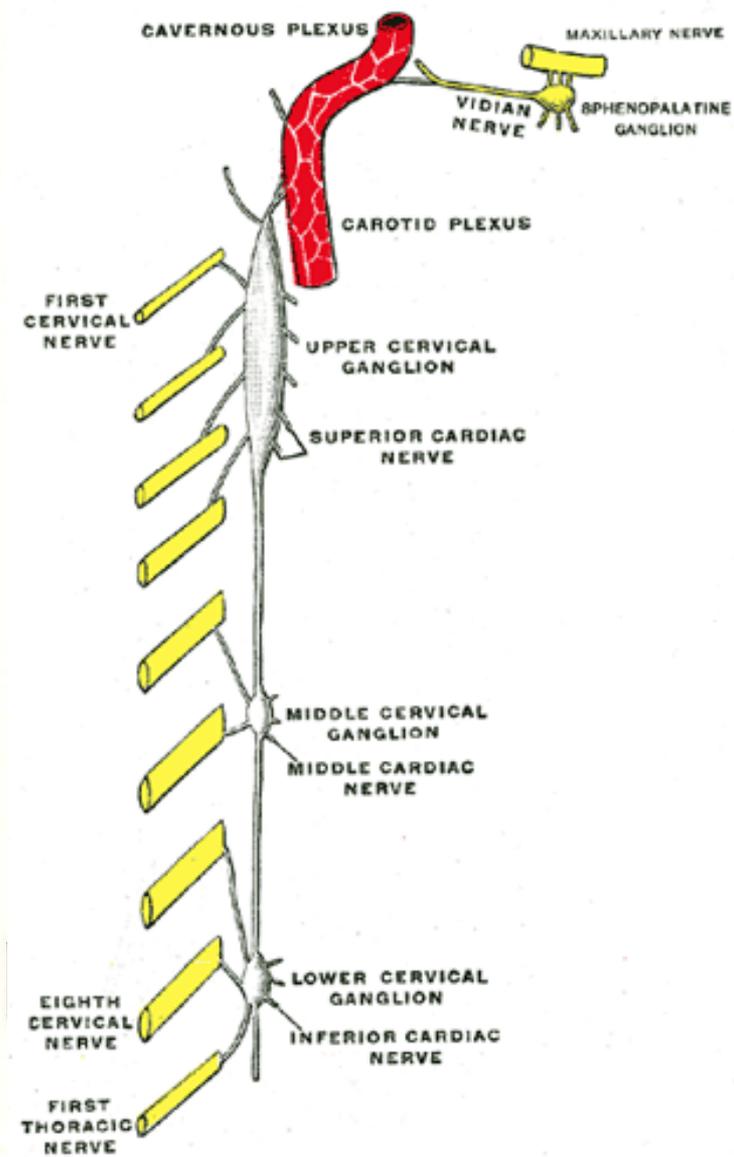
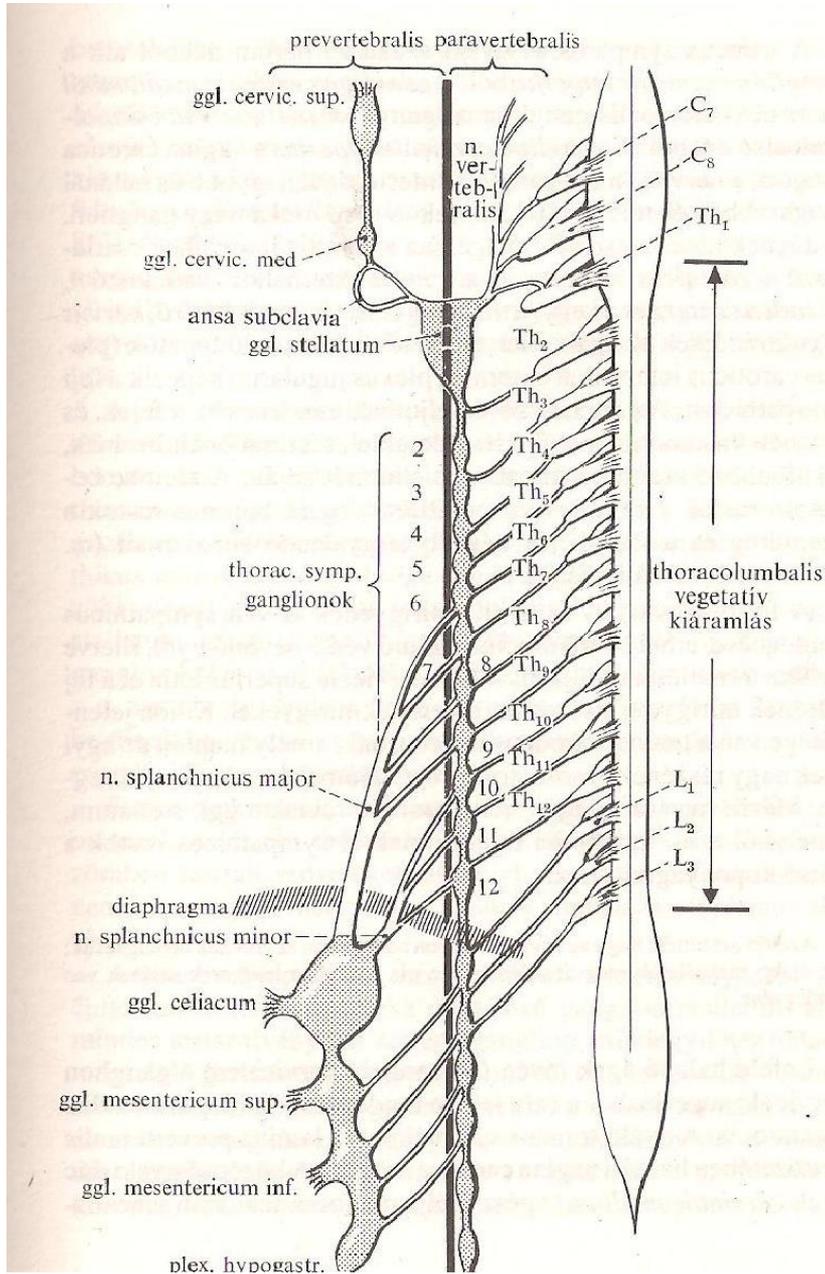
Grey and white communicating rami (Ramus communicans albus et griseus) = paravertebral ggl. Sympathetic trunk

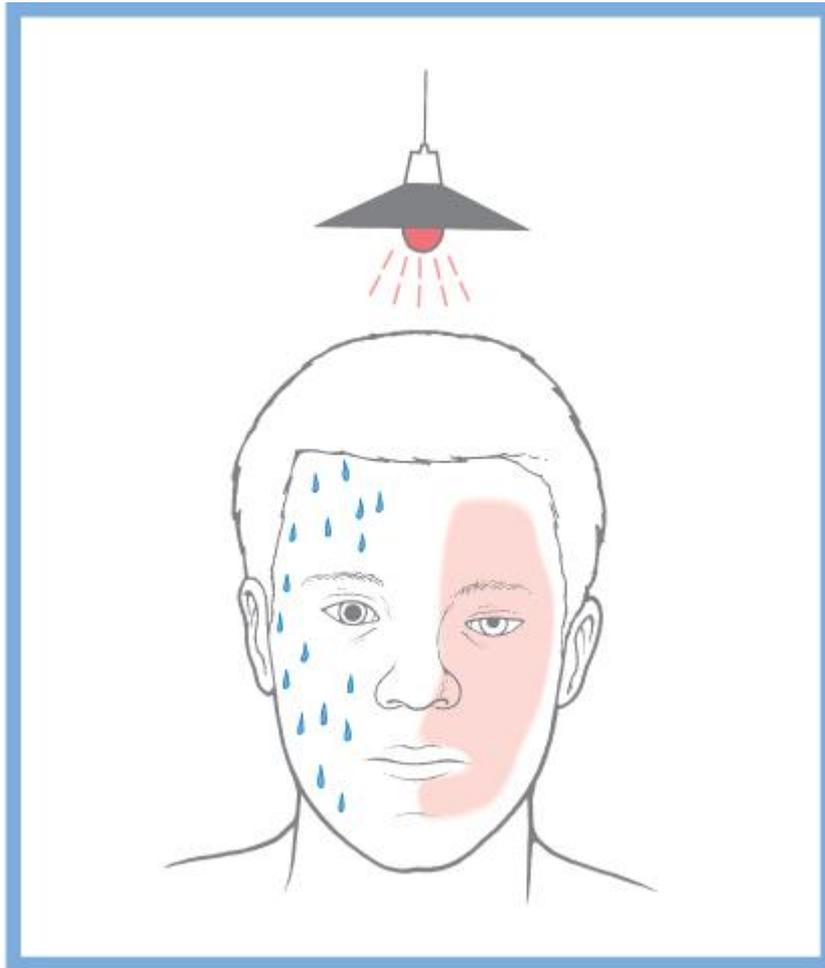


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Cephalic and cervical parts (Sup. and med. cervic. ggl.)





Horner's symptoms

Ptosis (sup. tarsal m.)

Enophthalmus (orbitalis m.)

Miosis (dilator m. of pupillae)

Anhidrosis (sweat glands)

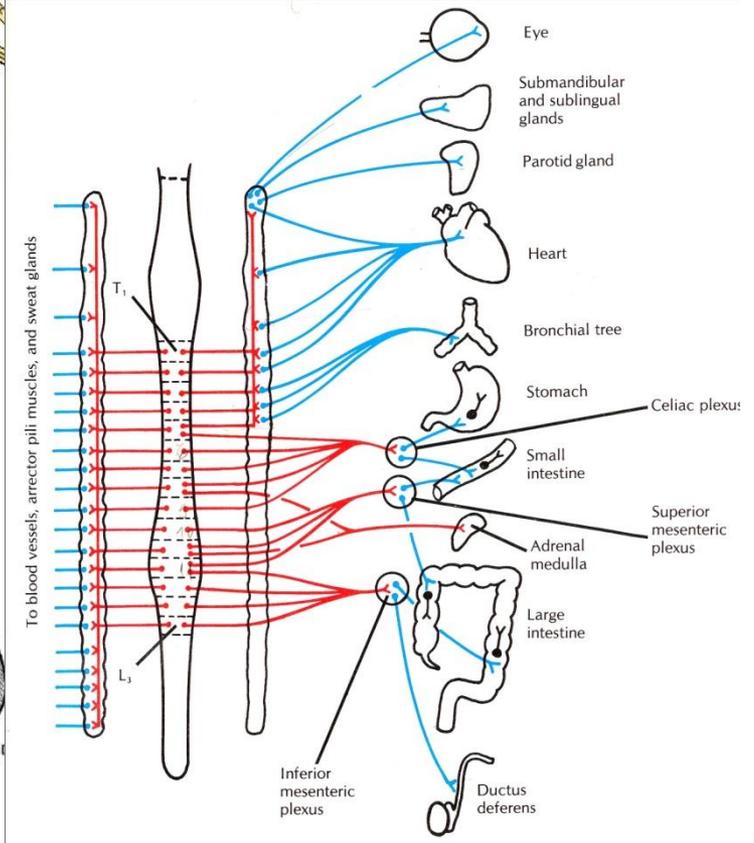
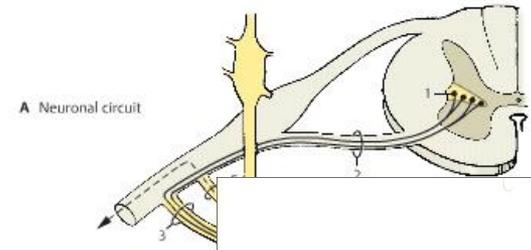
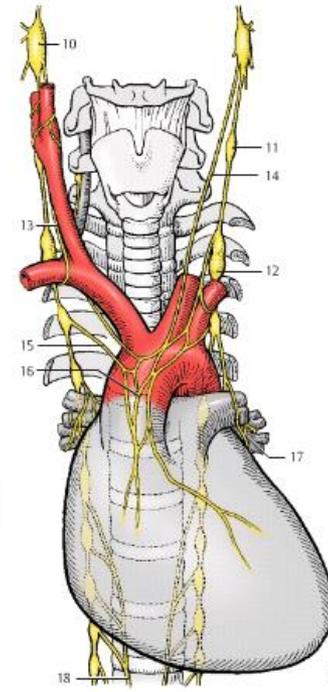
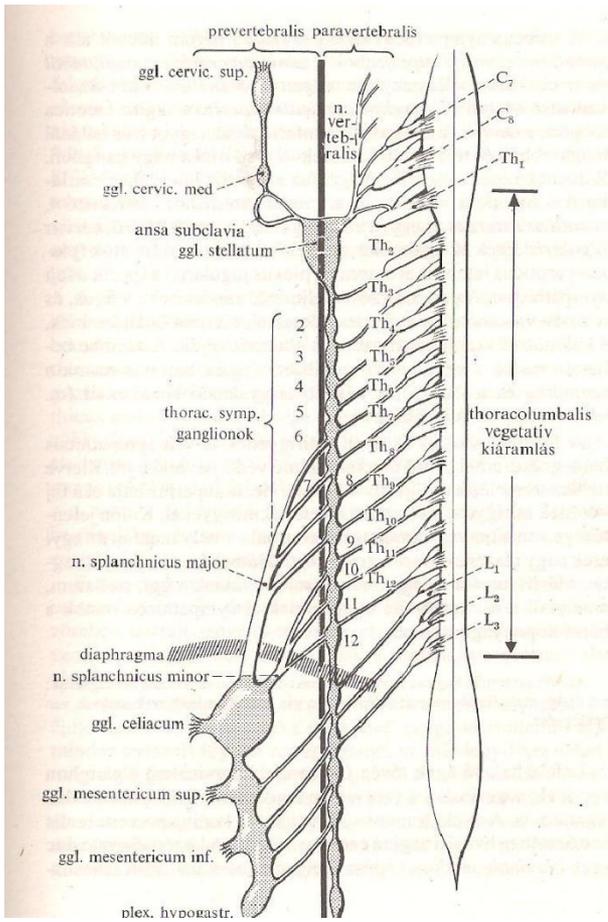


FIGURE 24-4. The sympathetic nervous system.

**Thoracic part
(Stellate ggl. (ggl. cervicothoracicum))**

Abdominal and pelvic parts

Splanchnic nerves!!!

Adrenal medulla!!!

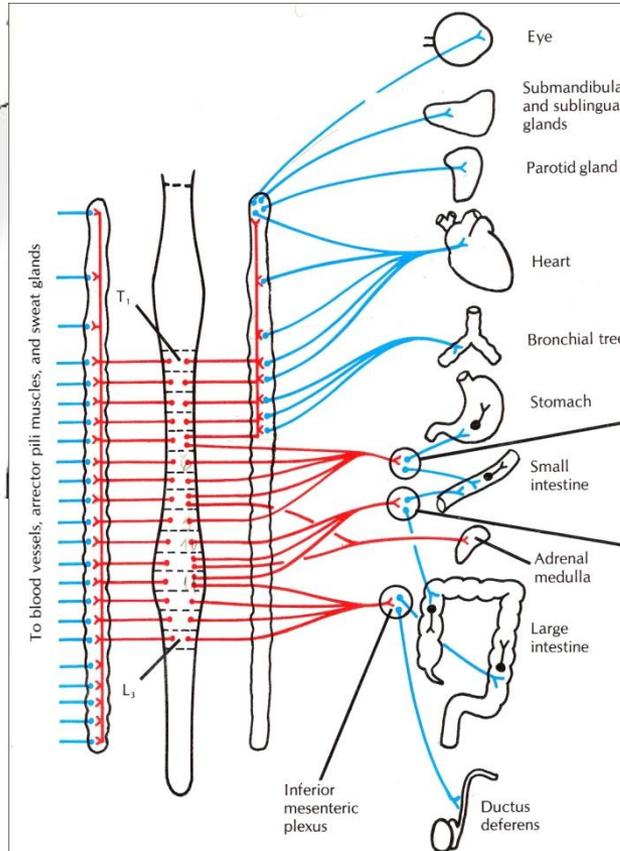
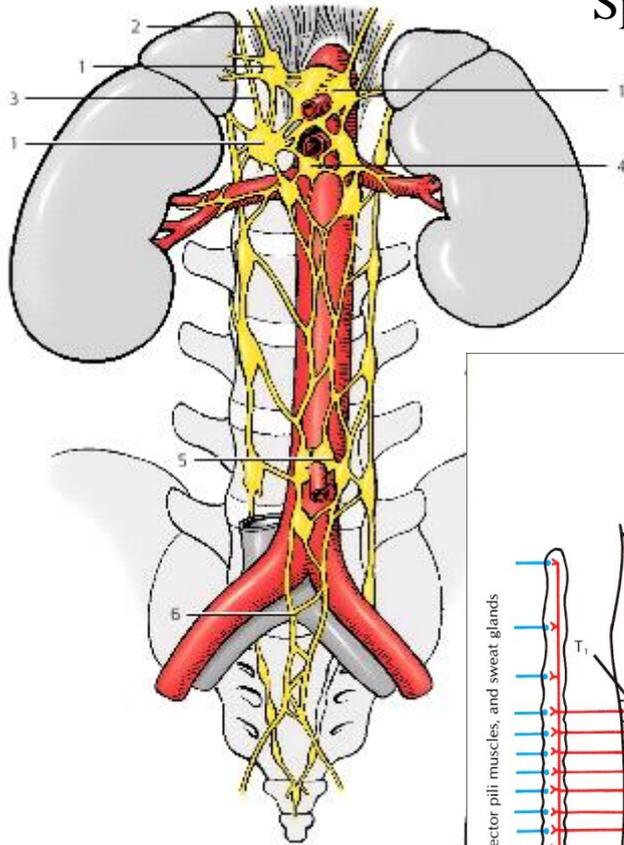


FIGURE 24-4. The sympathetic nervous system.

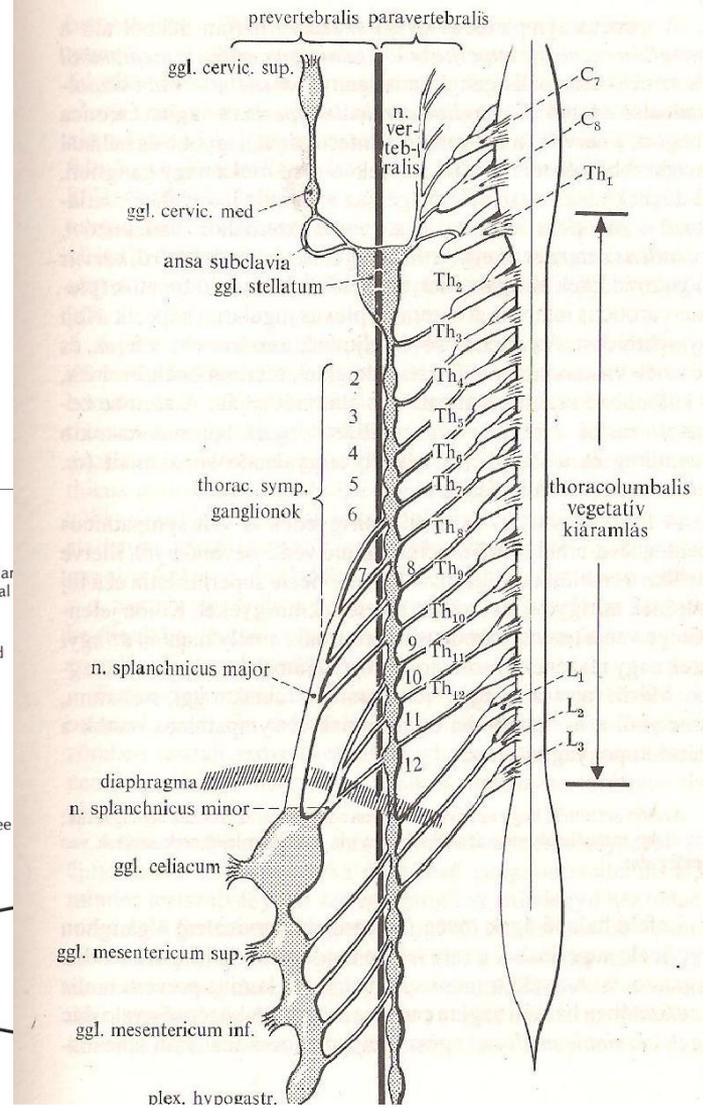


FIGURE 24-4. The sympathetic nervous system.

Parts of the parasympathetic NS:

Cranial part

General visceromotor cranial nerve nuclei

Sacral part

low sacral levels

sacral preganglionic fibers join to

- branches of the pudendohemorrhoidal plexus
- pelvic visceral plexuses,
- nn. splanchnici pelvini (nn. erigentes),
- ggl. of the local plexuses

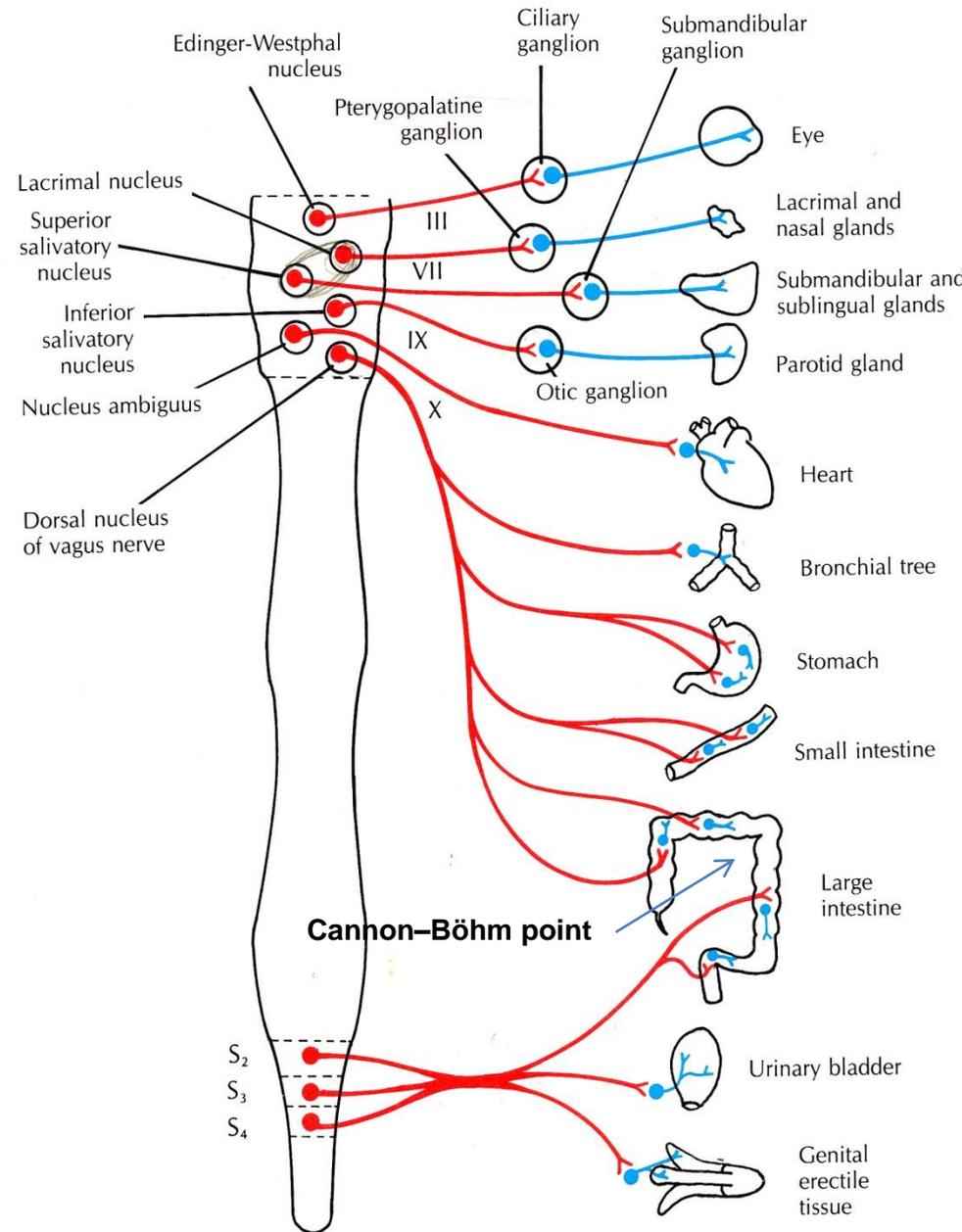


FIGURE 24-3. The parasympathetic nervous system.

Cranial parasympathetic system (outflow) - long praeganglionic fibers!!!

oculomotor accessory nucl. E.W

CN. III. → ciliary ggl. → nn. ciliares breves → m sphincter pup.
m. ciliaris

Sup. Salivatory nucl. (CN. VII.)

n. petrosus major → pterygopalatine ggl. → n. zyg. n. lac.
nn. palatini V/2 → lacrimal gl.
nn. nasales → palatine gl.
nasal gl.

chorda tympani → submandibular ggl. → n. lingualis V/3 → submandibular gl..
sublingual gl.
ant. lingual gl.

Inf. Salivatory nucl. (CN. IX.)

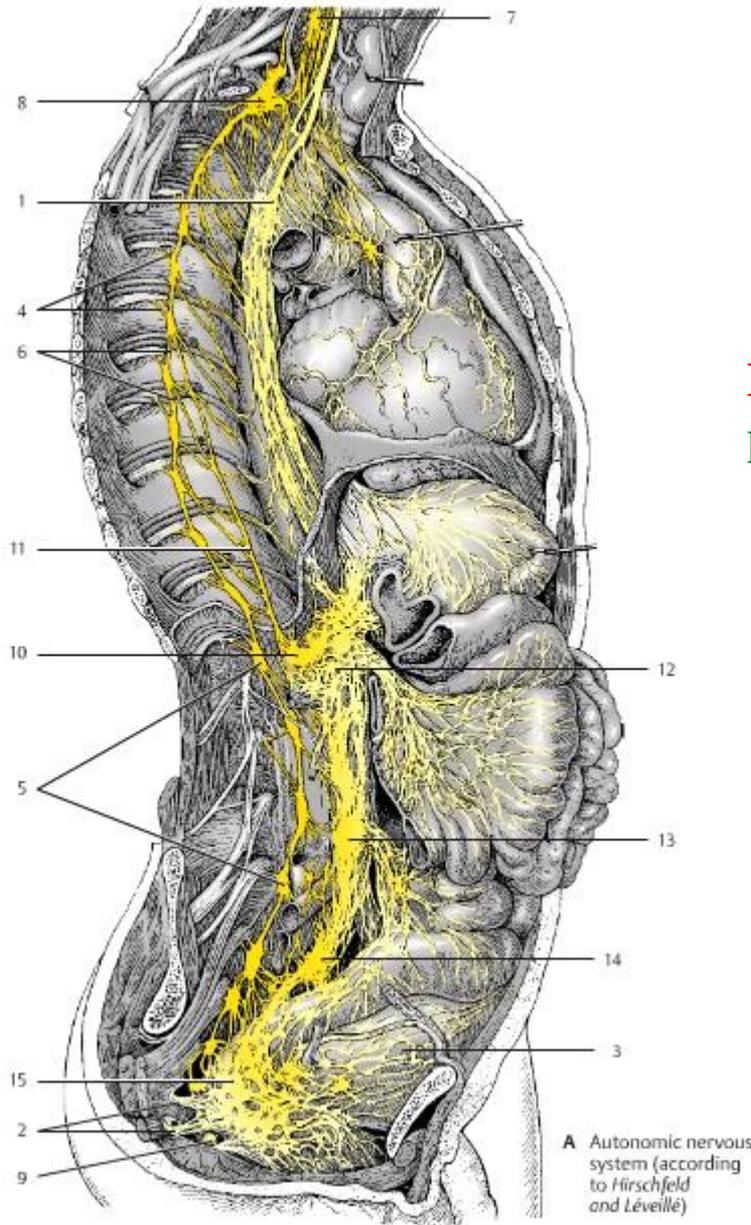
n. tympanicus, n. petrosus minor → otic ggl. → n. auriculotemp. V/3 → parotid gl.

nucleus alae cinerea medialis (dorsalis nucl. of CN. X.)

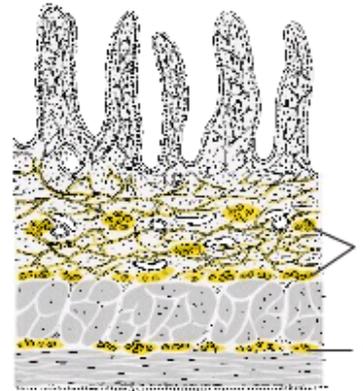
Branches to visceral organs → intramural ggl. → postganglionic fibers → smooth muscles
and glands

Vegetative plexuses

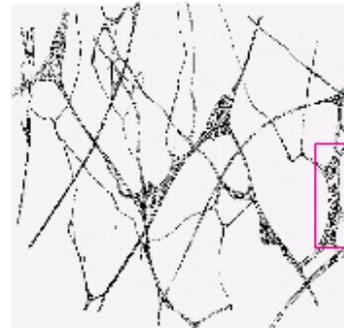
Postganglionic sympathetic and
praeganglionic parasympathetic fibers



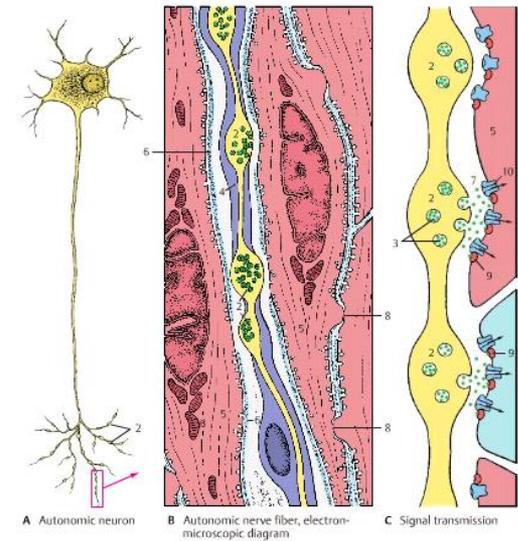
Enteric nervous system



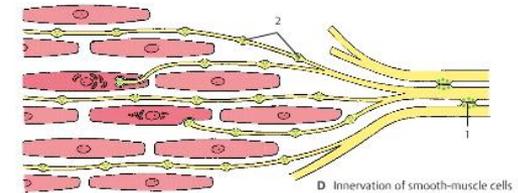
C Intestinal wall, diagram



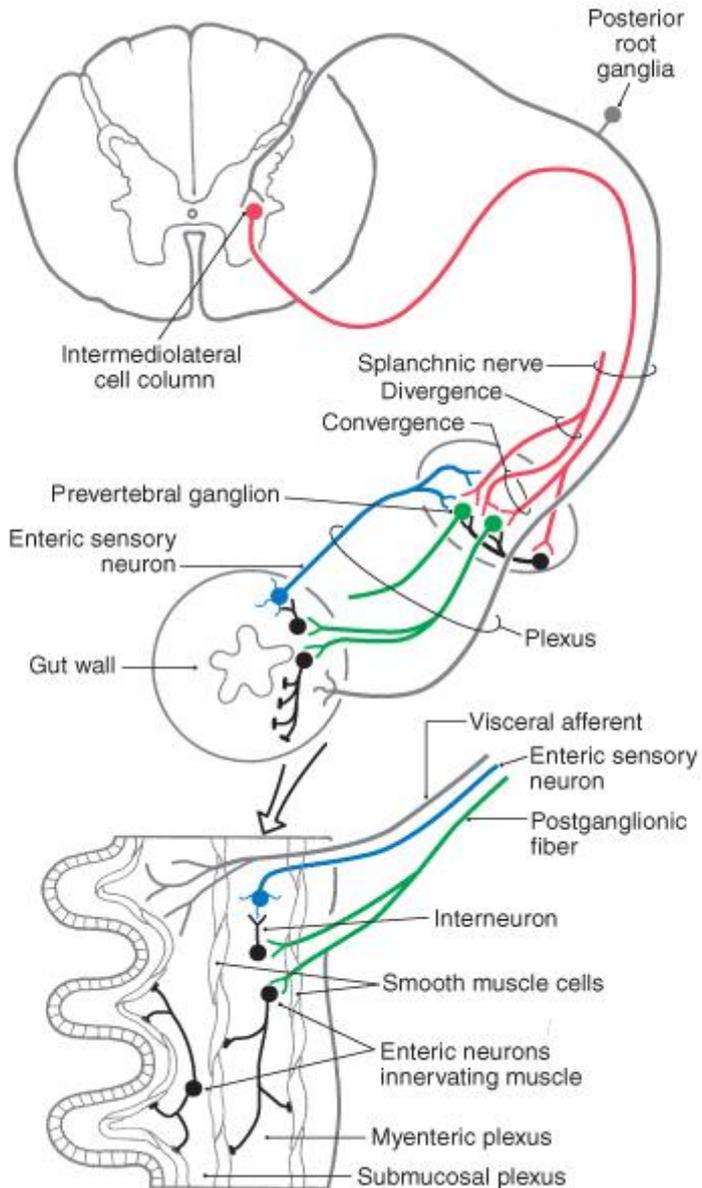
D Submucosal plexus

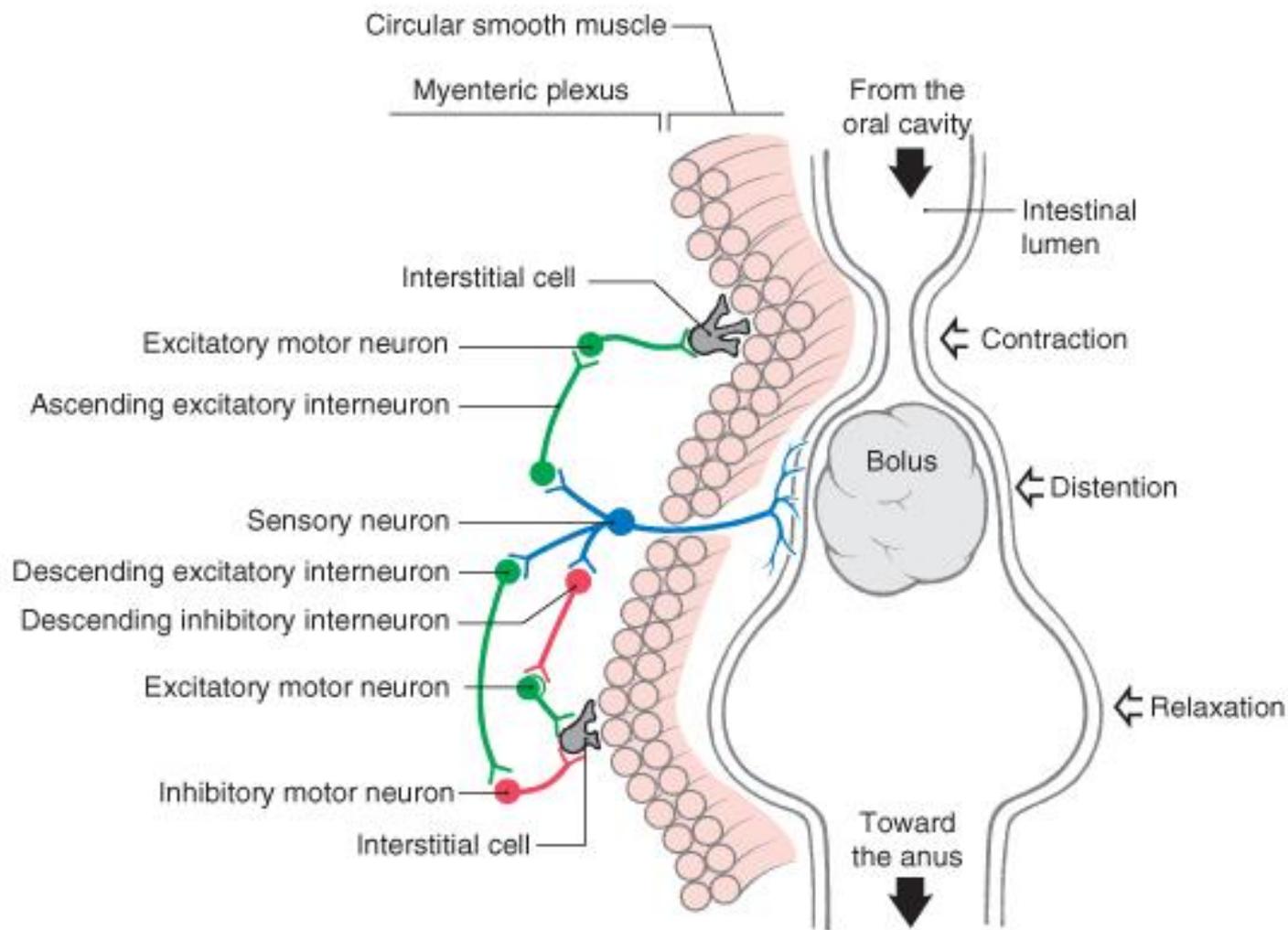


A Autonomic neuron B Autonomic nerve fiber, electron-microscopic diagram C Signal transmission



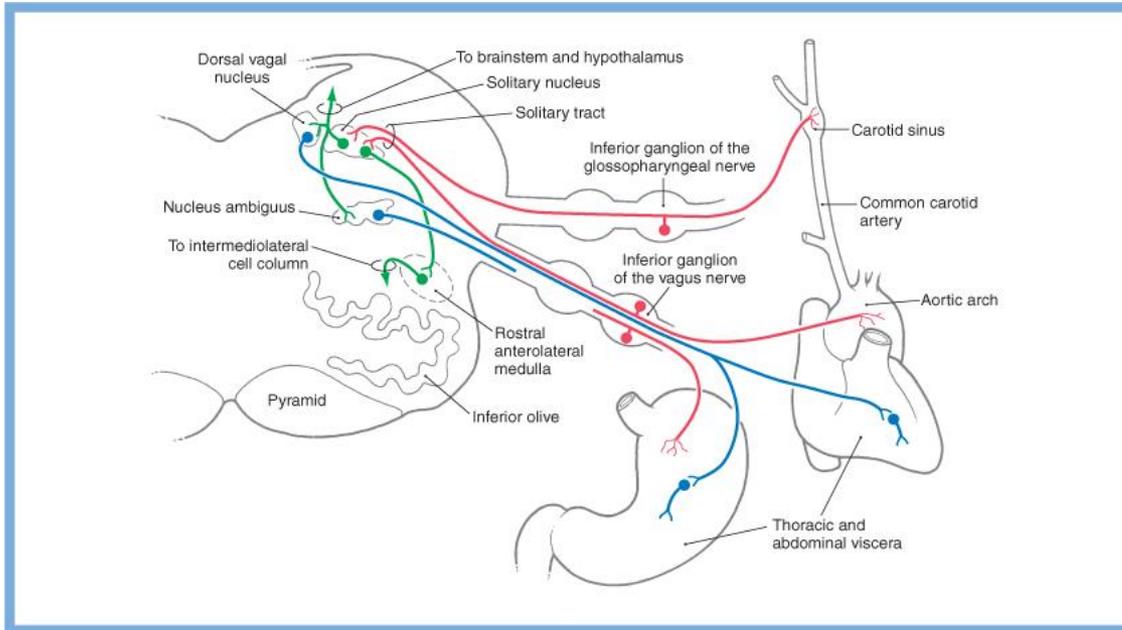
D Innervation of smooth-muscle cells



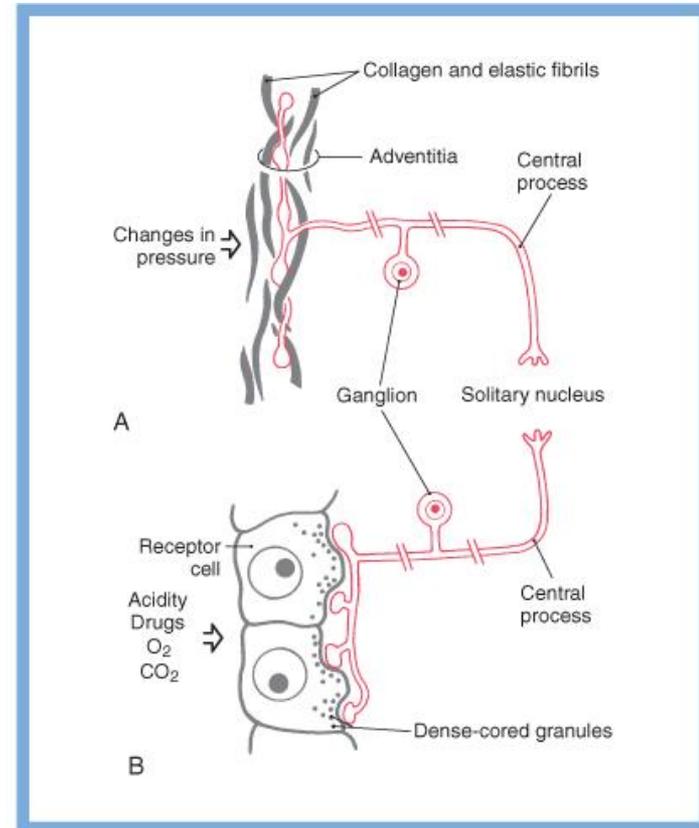


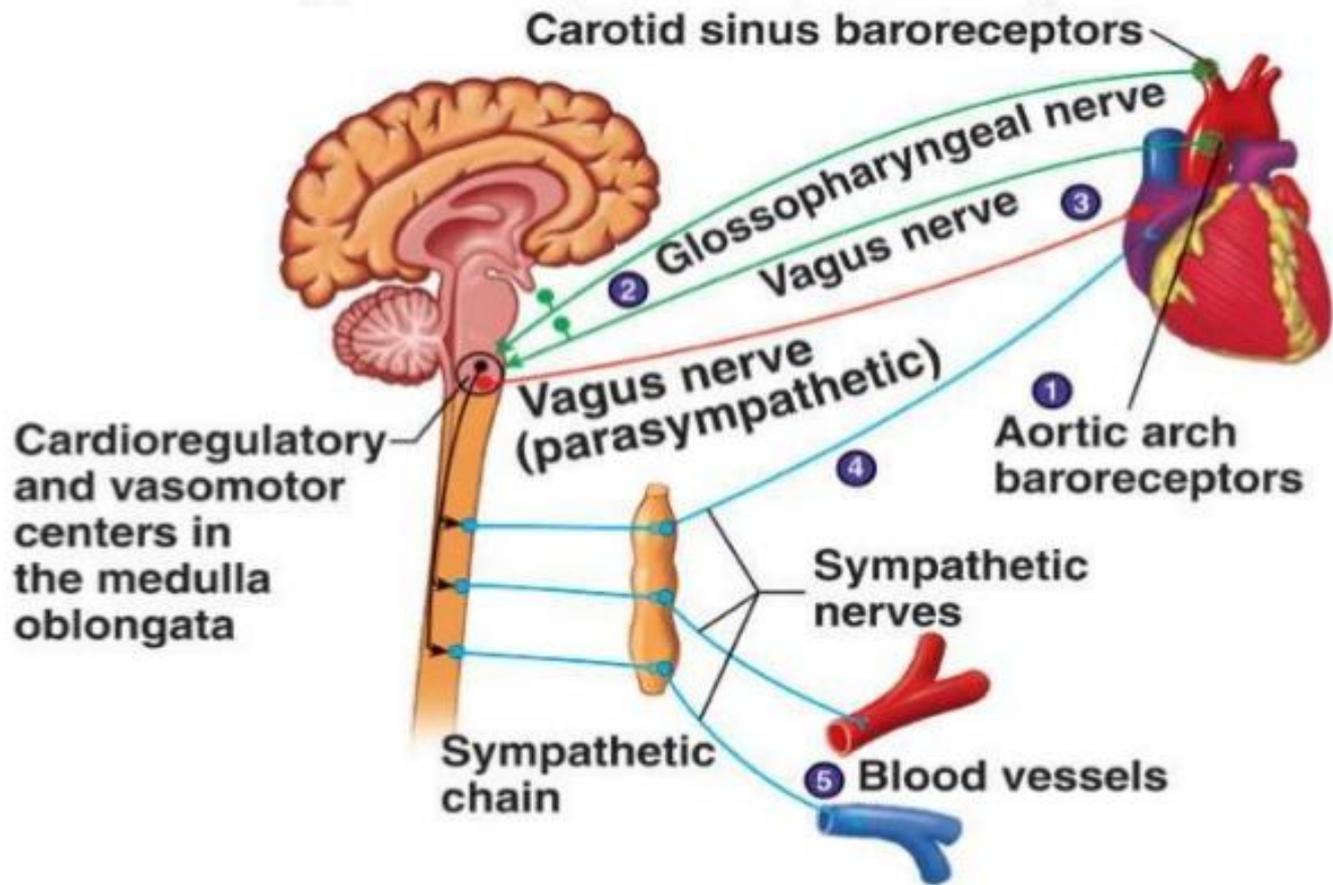
Vegetative afferents

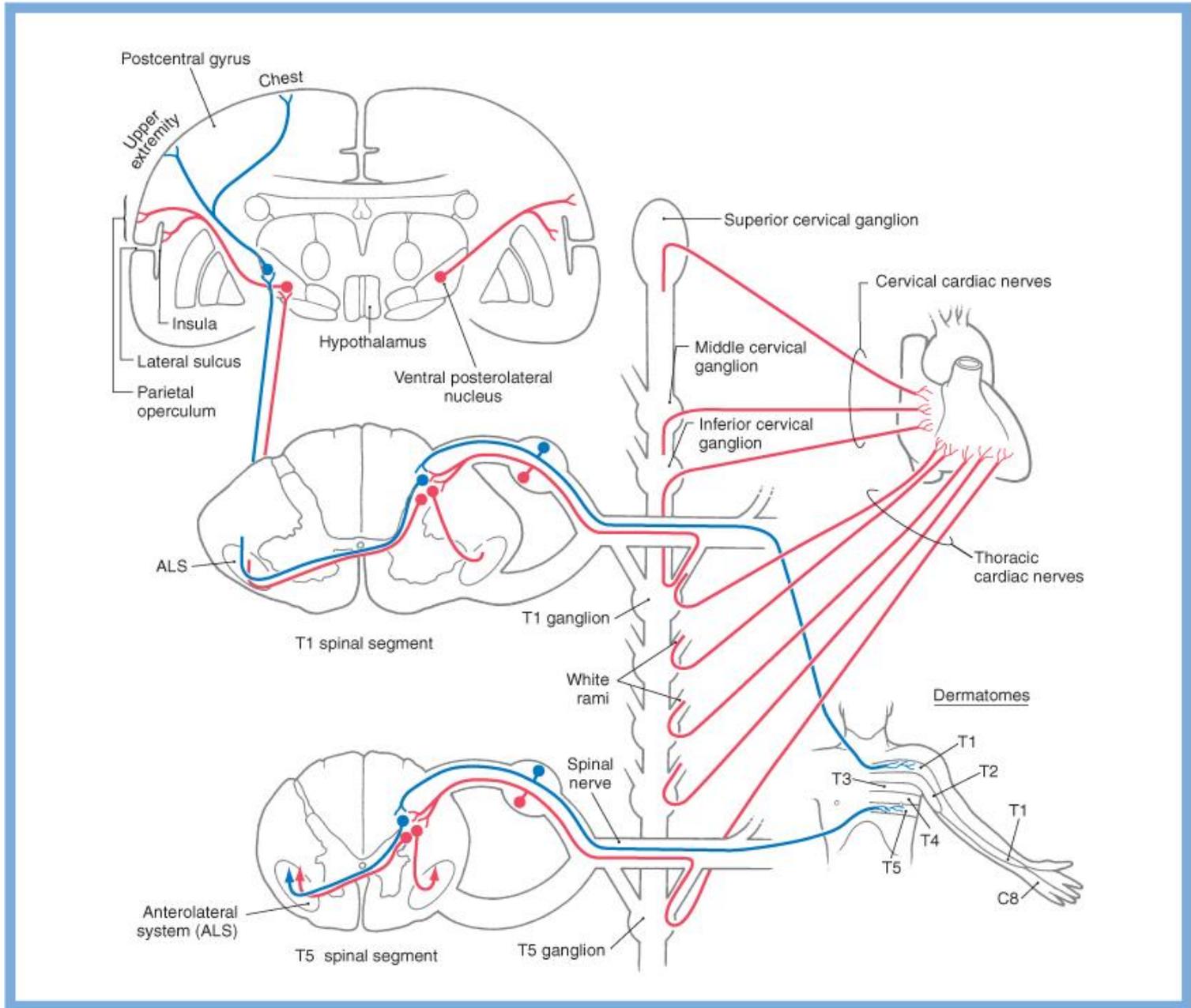
(blood pressure regulation, gas level monitoring, regulation of digestion)



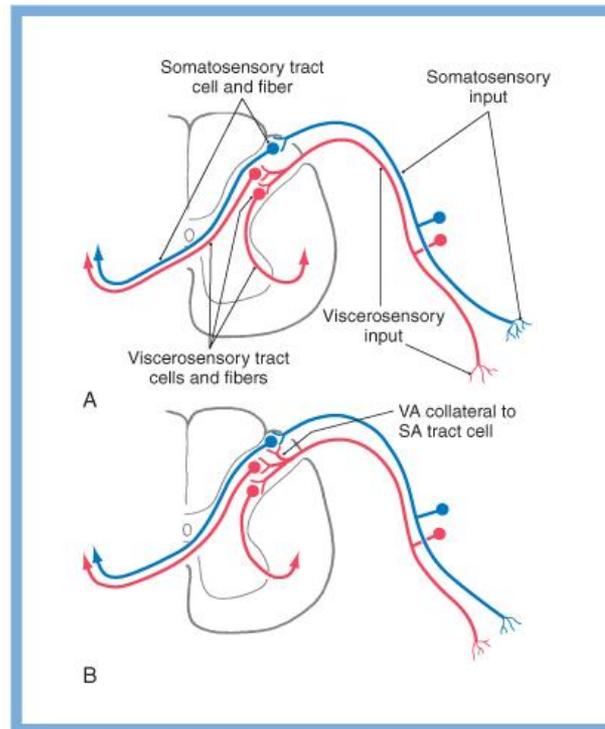
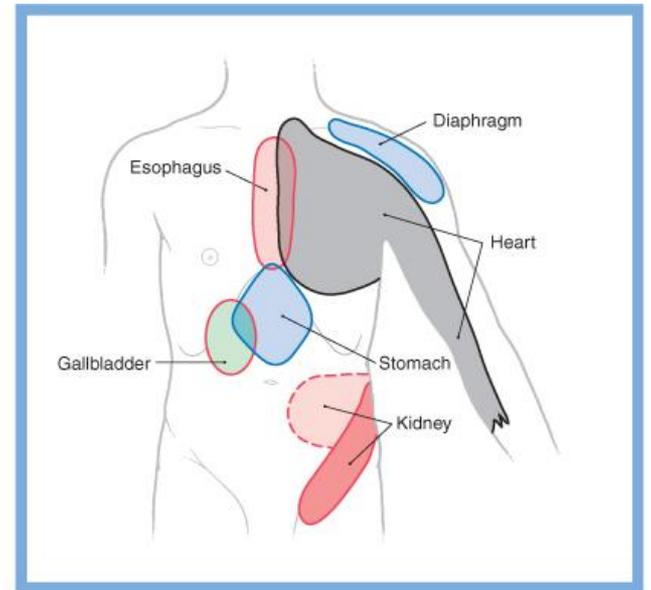
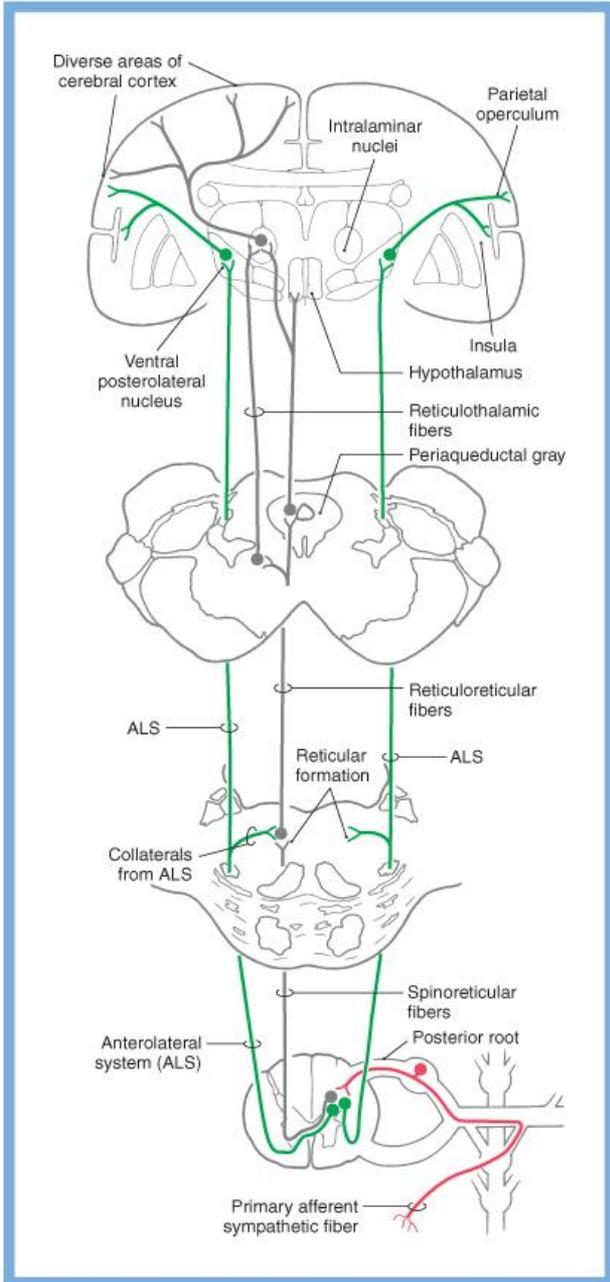
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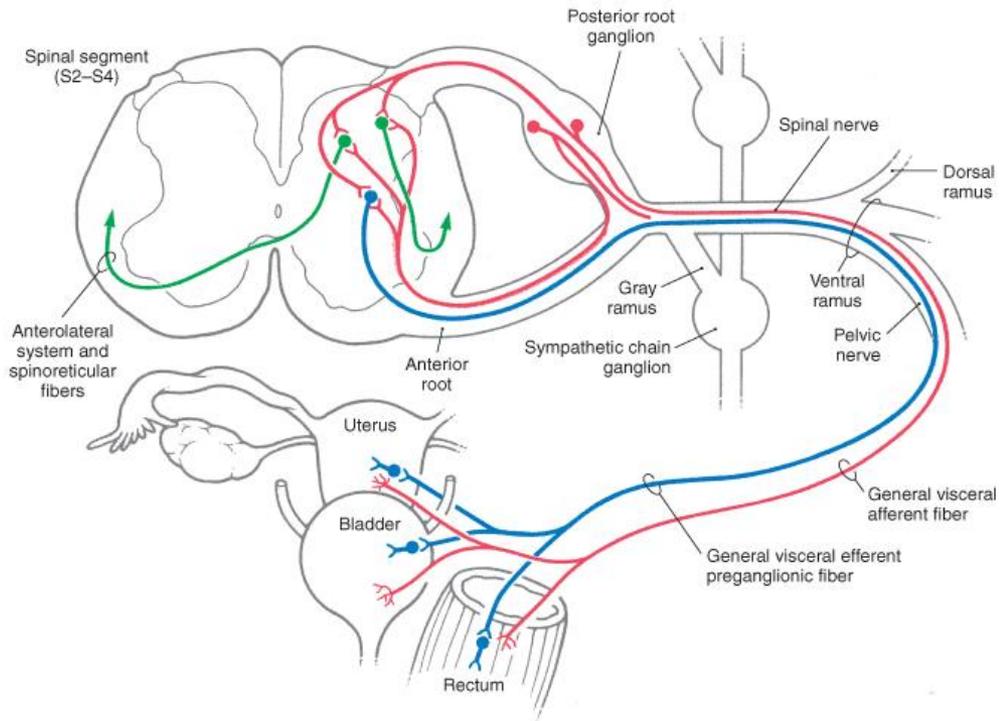
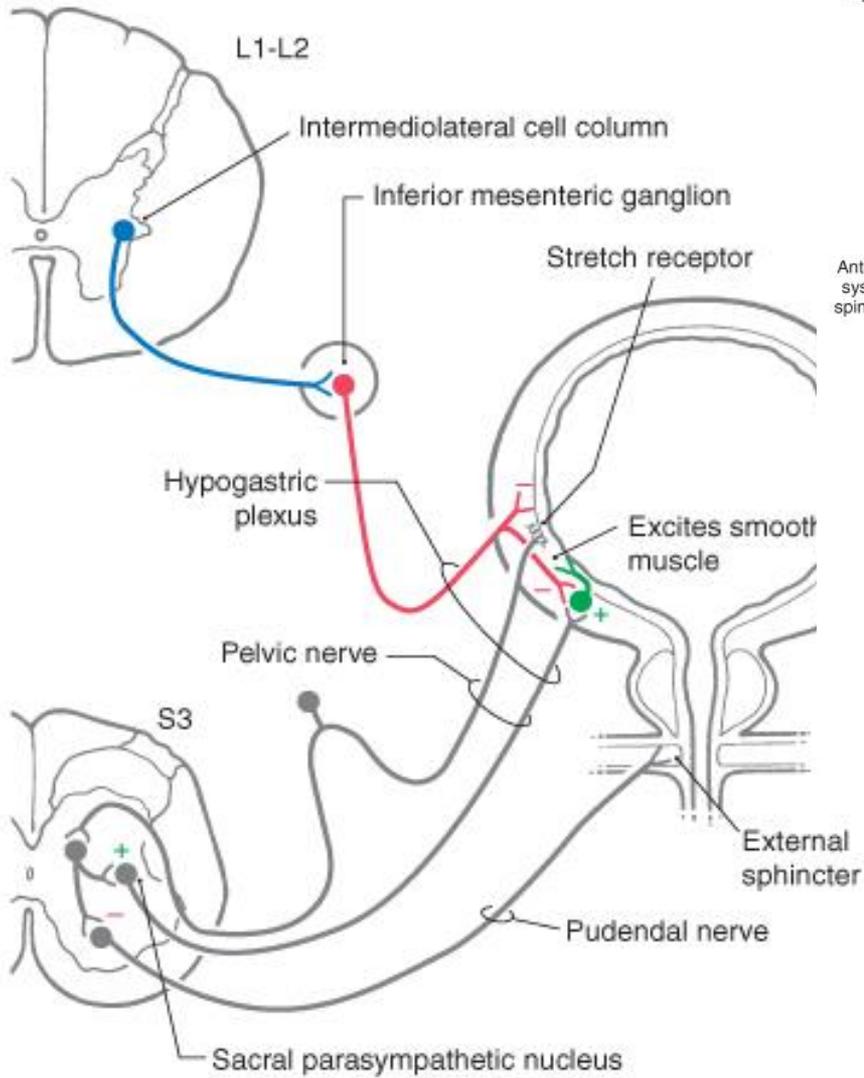


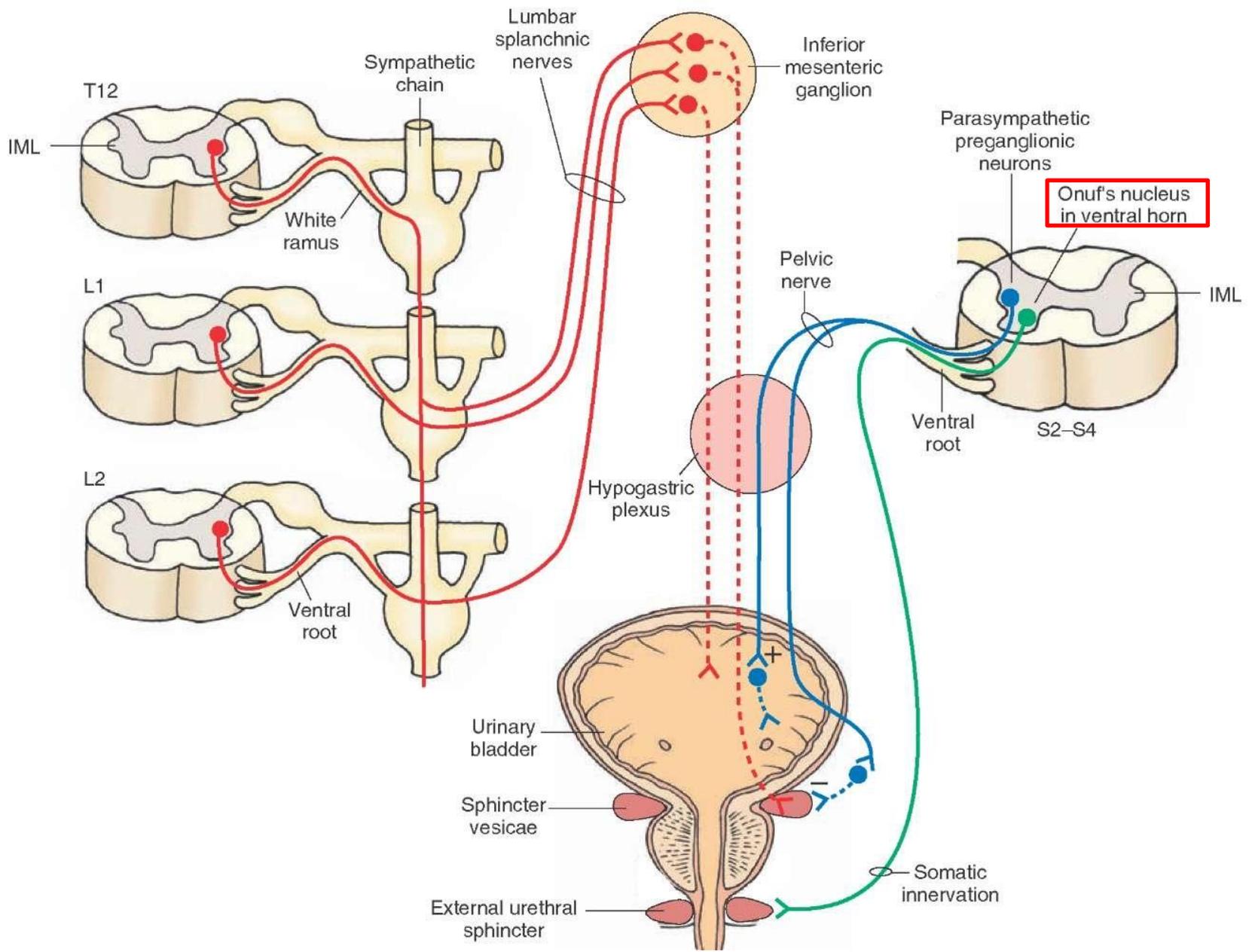


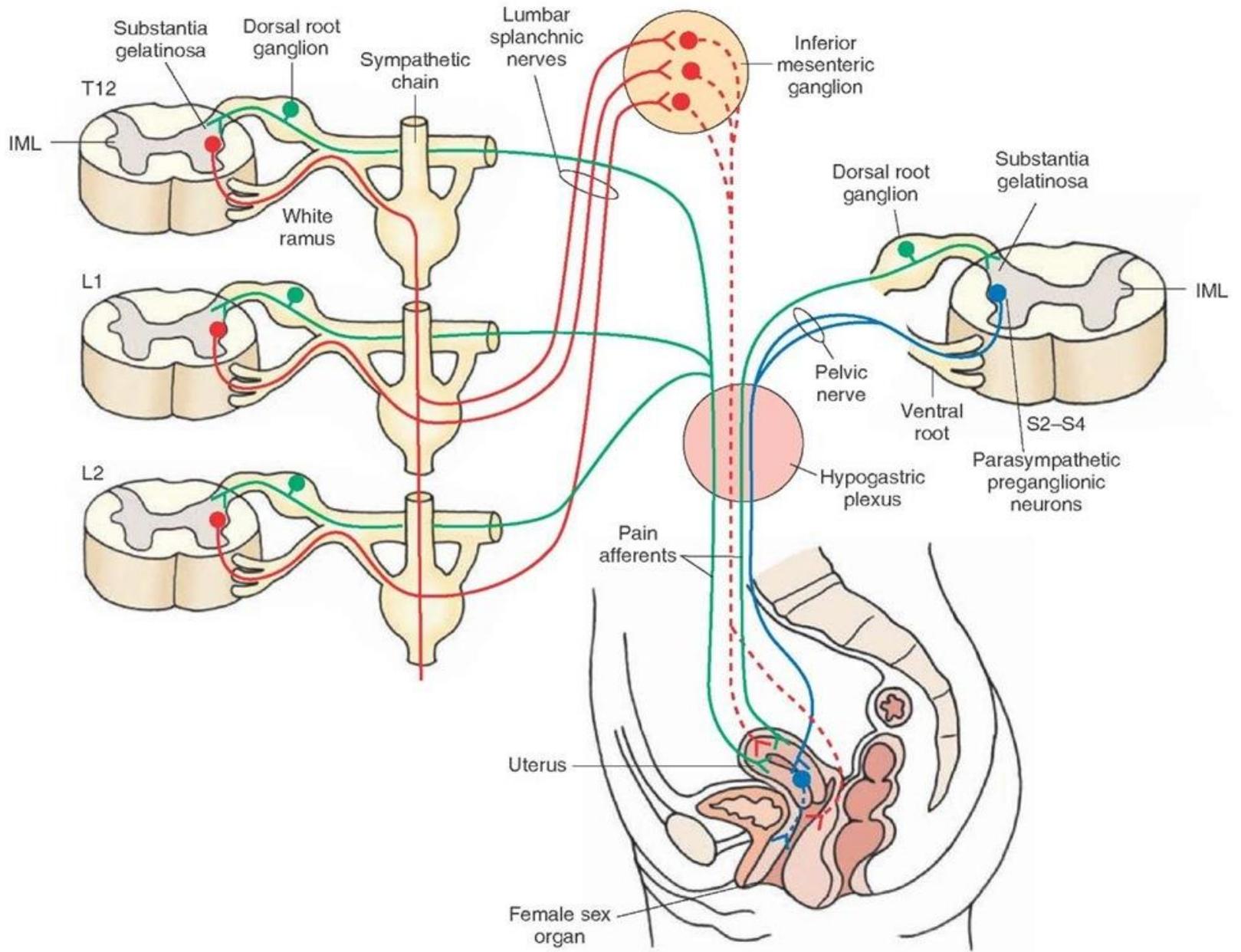
Head's zones

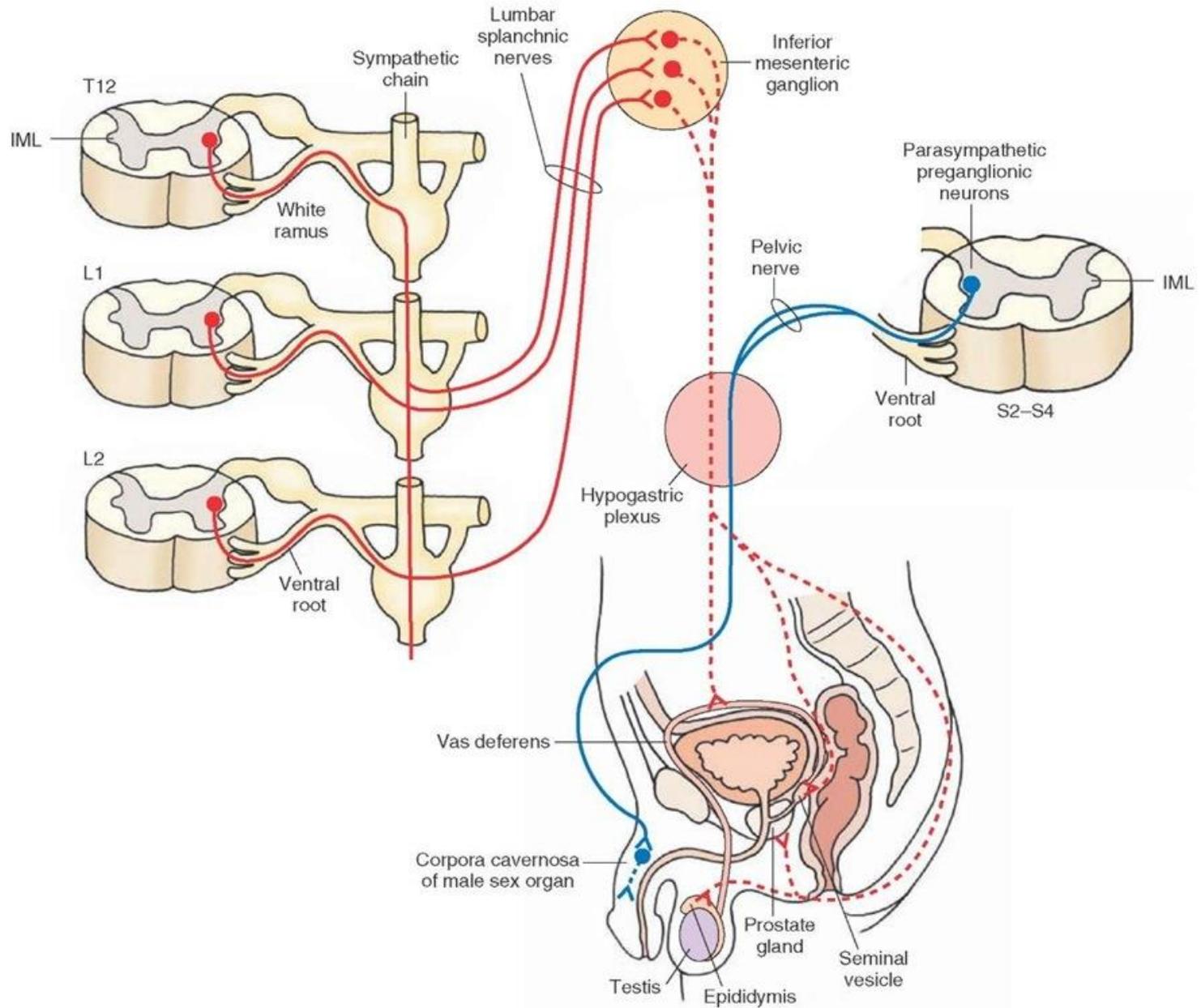


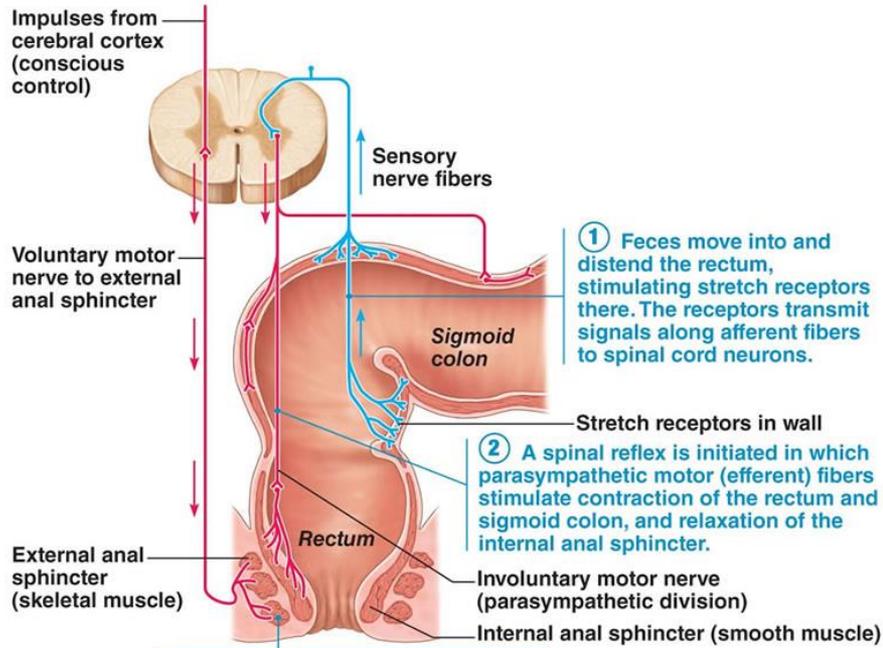
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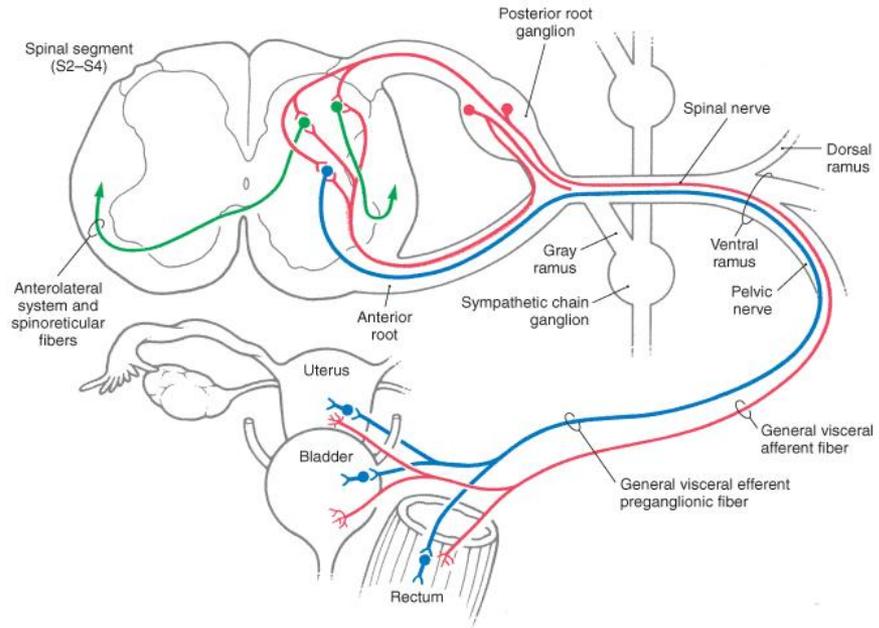


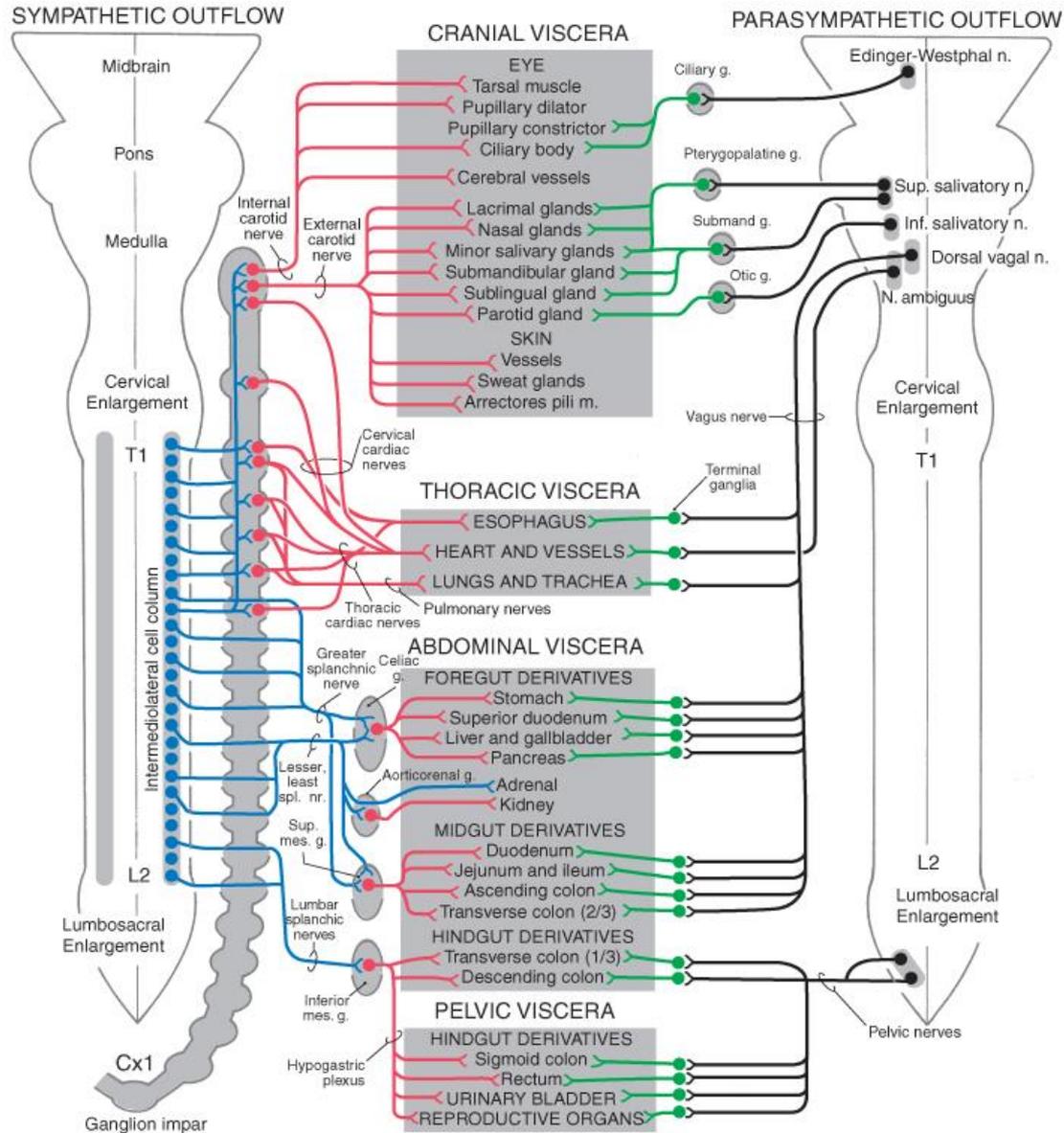


① Feces move into and distend the rectum, stimulating stretch receptors there. The receptors transmit signals along afferent fibers to spinal cord neurons.

② A spinal reflex is initiated in which parasympathetic motor (efferent) fibers stimulate contraction of the rectum and sigmoid colon, and relaxation of the internal anal sphincter.

③ If it is convenient to defecate, voluntary motor neurons are inhibited, allowing the external anal sphincter to relax so feces may pass.





The central regulation of the vegetative nervous system

Hypothalamus

The main central CNS region which influences the vegetative NS

- cardiovascular system
- body temperature
- osmotic regulation (water and ions)
- energy and metabolism

Vegetative nervous system and endocrine system together maintained the homeostasis of the body

Hypothalamus has connections with higher brain regions and influenced by them (limbic system - how emotions are affected us somatically?).