

Systemic Module

GIT

“Anatomy”

Innervation and Lymphatics of GIT

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Innervation of GIT

Innervation of Abdominal Viscera

- Abdominal viscera are innervated by both **extrinsic and intrinsic** components of the nervous system:
 1. **Extrinsic innervation** involves receiving motor impulses from, and sending sensory information to, the central nervous system.
 2. **Intrinsic innervation (Enteric Nervous System)** involves the regulation of GI tract activities by local neuronal circuit of sensory and motor neurons in the wall of GI tract.

Extrinsic innervation

- Abdominal viscera receiving extrinsic innervation include:
 - The abdominal part of the gastrointestinal tract,
 - Pancreas
 - Liver
 - Gallbladder
 - Spleen
- These viscera send sensory information back to the CNS through **visceral afferent fibers** (sensory neurons) and receive motor impulses from the CNS through **visceral efferent fibers** (motor neurons).
- The visceral efferent fibers include both the **sympathetic** and **parasympathetic** fibers of the autonomic nervous system .

The Autonomic Nervous System ??

- The peripheral nervous system is divided into the **somatic nervous system (SNS)** and the **autonomic nervous system (ANS)**:
 1. The **SNS** supplies the skeletal muscles (associated with the voluntary control of body movements)
 2. The **ANS** supplies the smooth muscles, cardiac muscle, and glands (associated with the involuntary control of internal organ like heart rate, respiratory rate, digestion, glands secretions)
- The ANS is regulated by the **hypothalamus**
- The ANS has two divisions: **Sympathetic** and **Parasympathetic**

Sympathetic division

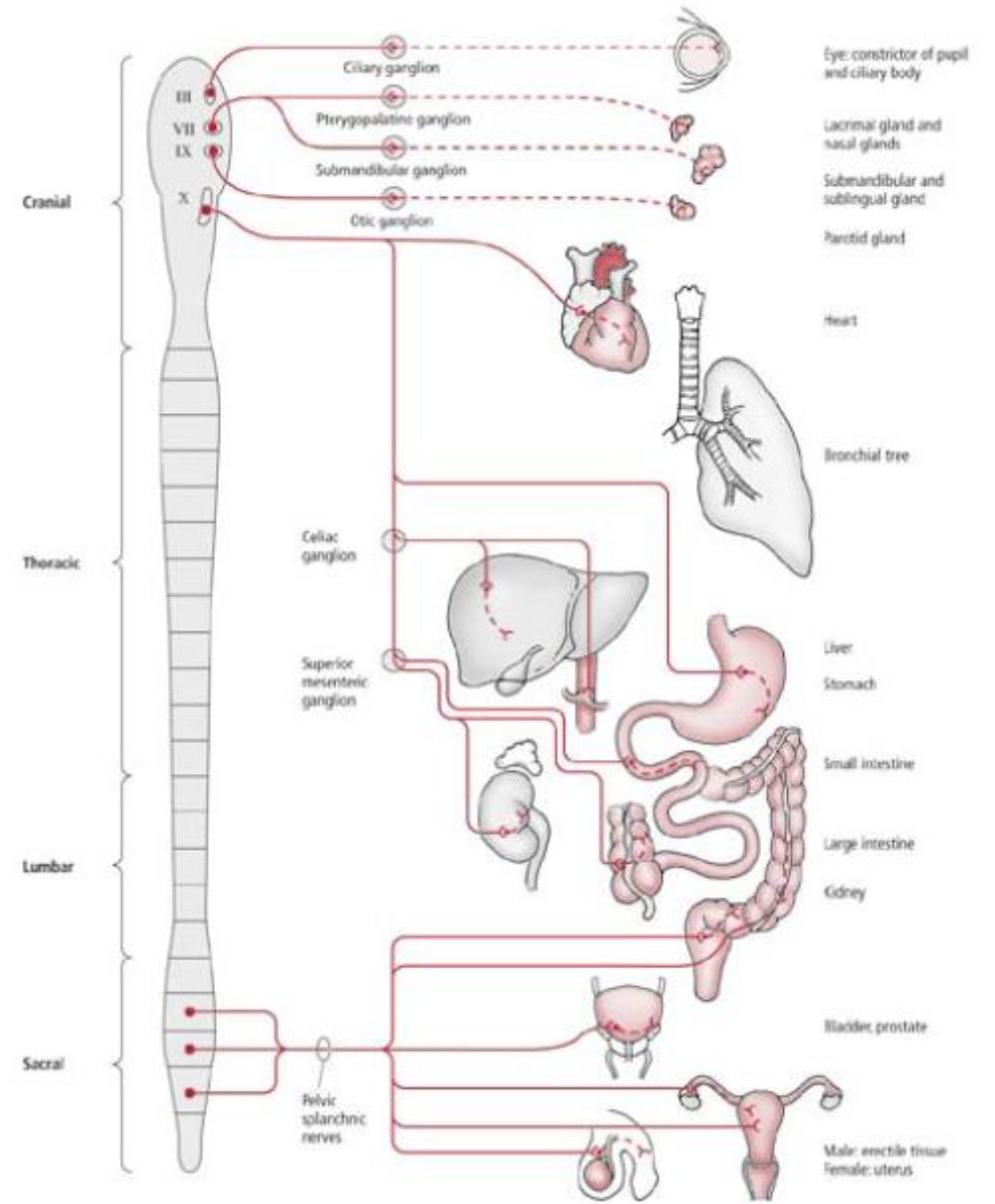
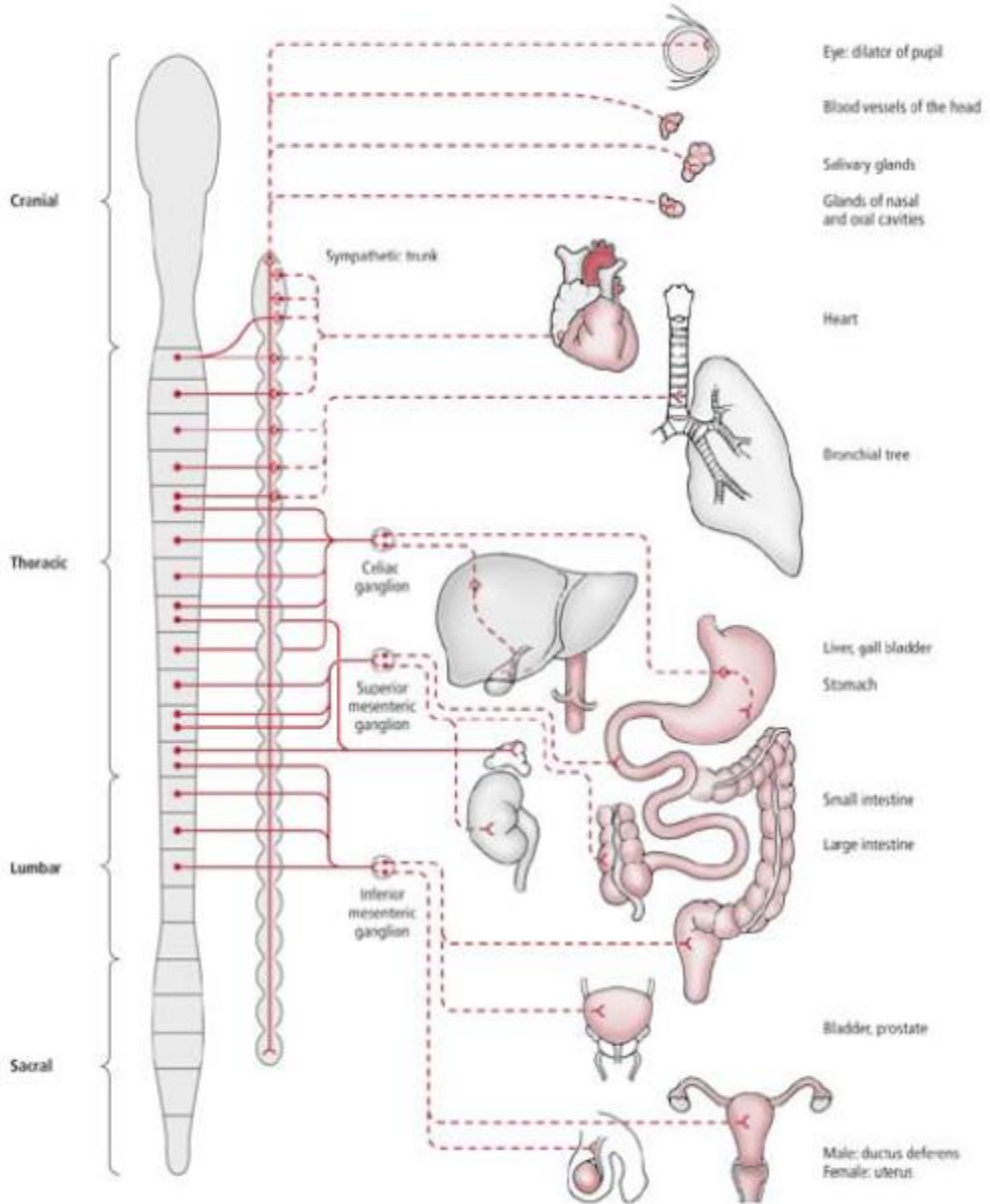
- Prepares the body for **stressful or emergency situations** - **fight or flight response**
- When stimulated, increase the heart rate, increase blood flow to the muscles
- The cell bodies of the preganglionic neurons occur in **thoracolumbar region of the spinal cord specifically at T1 to L2**
- Most of the ganglia for the sympathetic division **are located just outside the spinal cord on both sides of it**

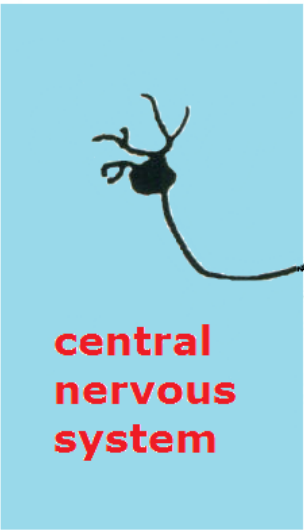
Parasympathetic division

- Controls body process during **ordinary situations** - **rest and digest response**
- When stimulated, increase digestive secretions and reduce the heart rate
- The cell bodies of the preganglionic neurons occur in the **brainstem** and in the **sacral spinal segments S2 – S4**
- The ganglia for the parasympathetic division **are located near or in the organs they connect with.**

Sympathetic division

Parasympathetic division





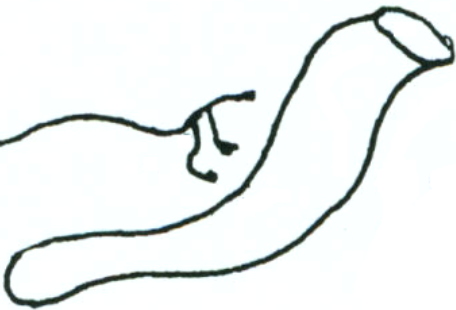
**central
nervous
system**

**pre-ganglionic
axon**

autonomic ganglion



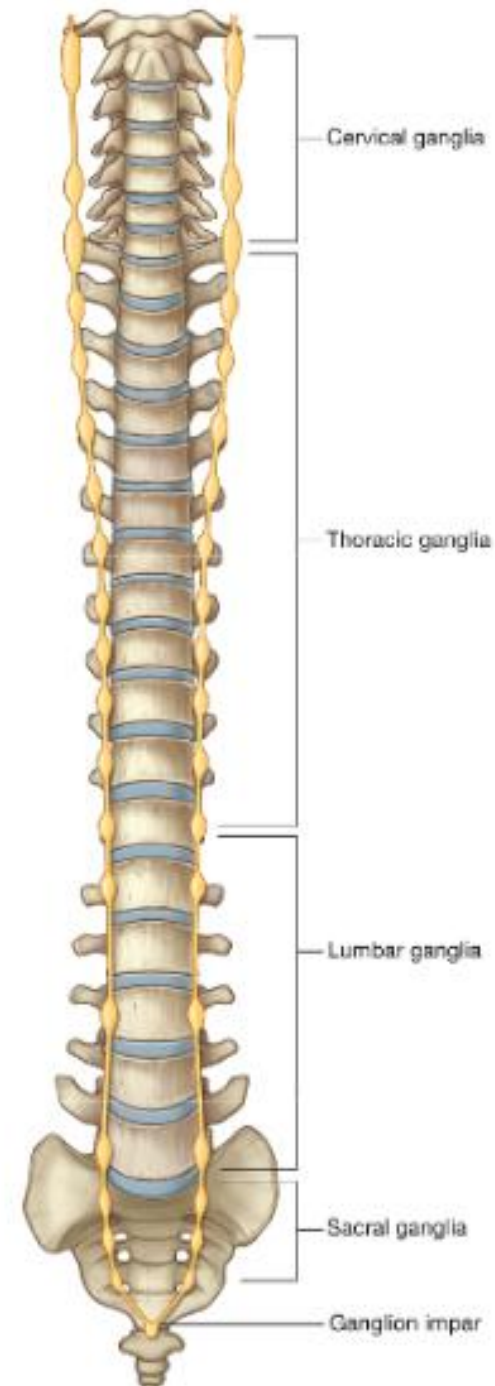
post-ganglionic axon



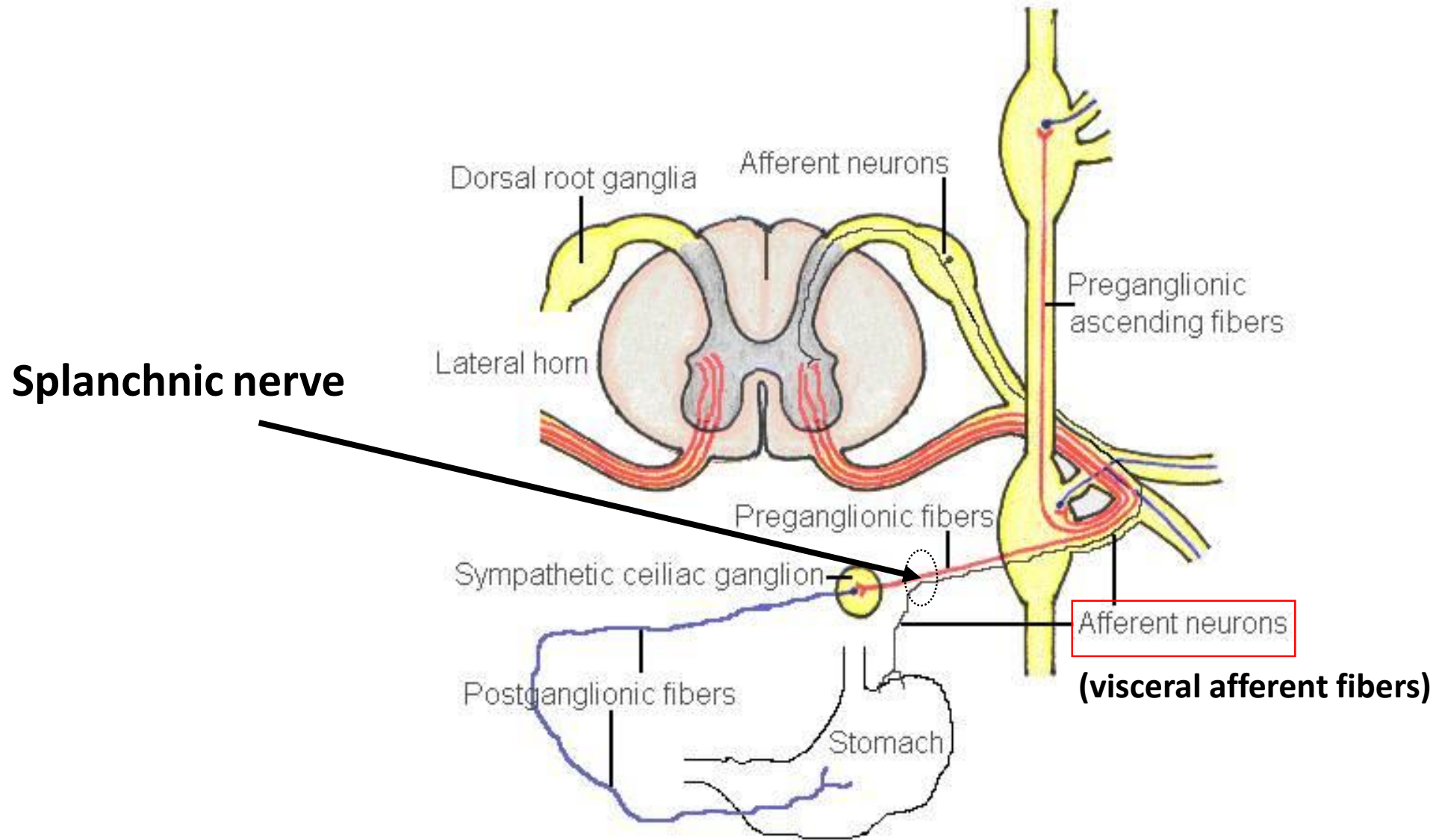
**visceral
effector
organ**

Sympathetic trunk

- The sympathetic trunks are two parallel nerve cords extending on either side of the vertebral column from the base of the skull to the coccyx
- Contain sympathetic ganglia called **paravertebral ganglia**:
 1. 3 in the cervical region
 2. 11 or 12 in the thoracic region
 3. 4 in the lumbar region
 4. 4 or 5 in the sacral region
- The two sympathetic trunks come together anterior to the coccyx to form the **ganglion impar**
- Neuronal fibers found in the sympathetic trunks include **preganglionic and postganglionic sympathetic fibers** and **visceral afferent fibers**.

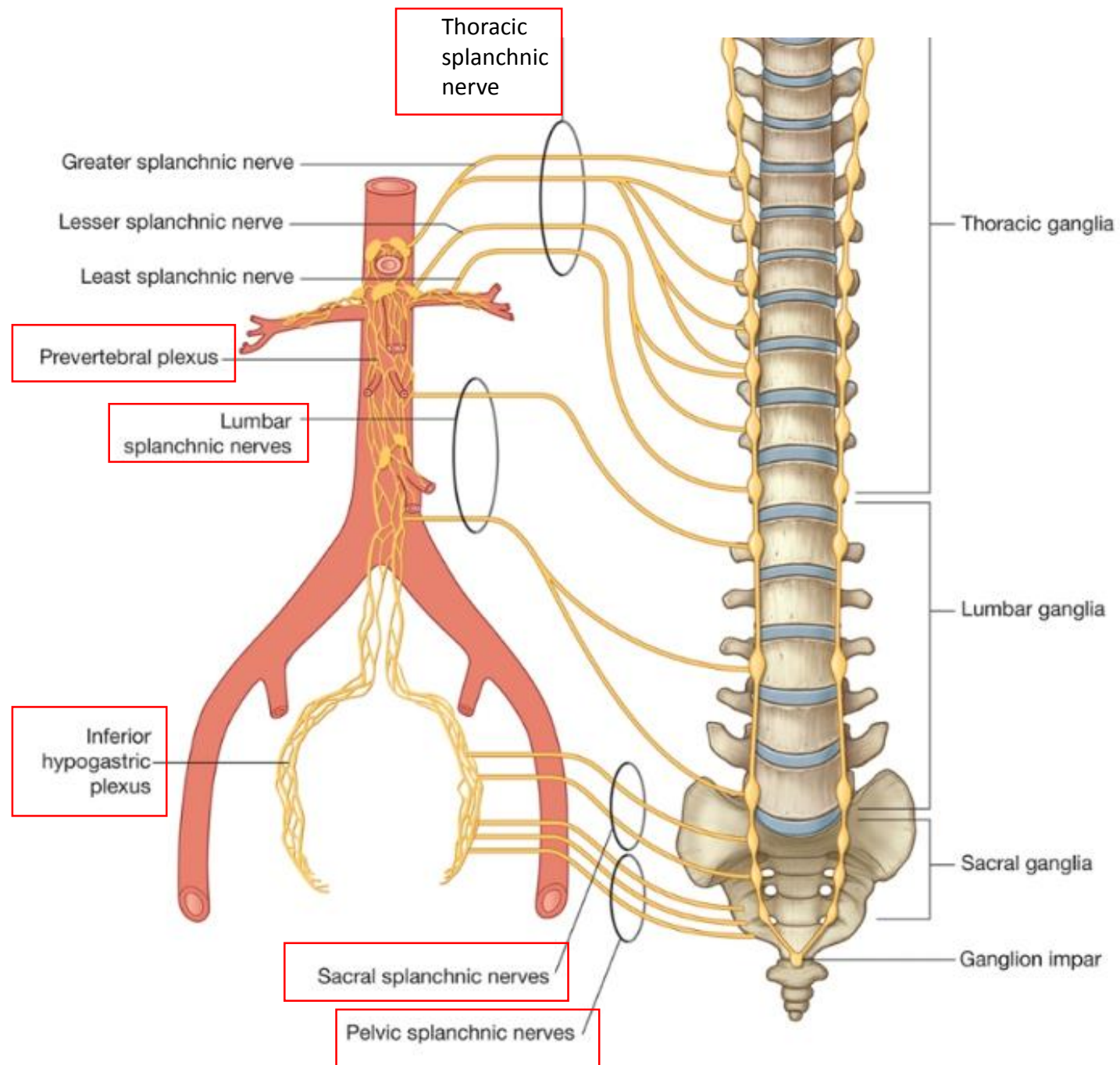


Sympathetic trunk



Sympathetic Innervation- Splanchnic Nerves

- The splanchnic nerves are important components in the innervation of the abdominal viscera.
- They are two types depending on the type of visceral efferent fiber they are carrying :
 1. The **THORACIC, LUMBAR,** and **SCARAL** splanchnic nerves carry the **(1) preganglionic sympathetic fibers** from the sympathetic trunk to **prevertebral (preaortic) ganglia** in the prevertebral plexus, also carry **(2) visceral afferent fibers**.
 2. The **PELVIC** splanchnic nerves (**parasympathetic root**) carry **preganglionic parasympathetic** fibers from the S2 to S4 spinal nerves to an extension of the prevertebral plexus in the pelvis (the inferior hypogastric plexus)



Splanchnic Nerves (Thoracic, Lumbar, Sacral)

(Sympathetic innervation)

- They carry the **preganglionic sympathetic fibers**, and pass from the sympathetic trunk to the prevertebral plexus and ganglia anterior to the abdominal aorta.
- Three **thoracic splanchnic nerves** pass from sympathetic ganglia along the sympathetic trunk in the thorax to the prevertebral plexus and ganglia associated with the abdominal aorta in the abdomen:
 1. The **greater splanchnic nerve** arises from the fifth to the ninth thoracic segments and travels to the celiac ganglia in the abdomen (a prevertebral ganglion associated with the celiac trunk).
 2. The **lesser splanchnic nerve** arises from the tenth and eleventh thoracic segments and travels to the aorticorenal ganglia.
 3. The **least splanchnic nerve** arises from the twelfth thoracic segment and travels to the renal plexus.

Splanchnic Nerves (Thoracic, Lumbar, Sacral)

(Sympathetic innervation)

- There are usually two to four **lumbar splanchnic nerves**, which arise from the lumbar segments and enter the prevertebral plexus
- The **sacral splanchnic nerves** arise from the lumbar segments and enter the inferior hypogastric plexus, which is an extension of the prevertebral plexus into the pelvis.

Sympathetic Splanchnic Nerves

Abdominopelvic splanchnic nn.

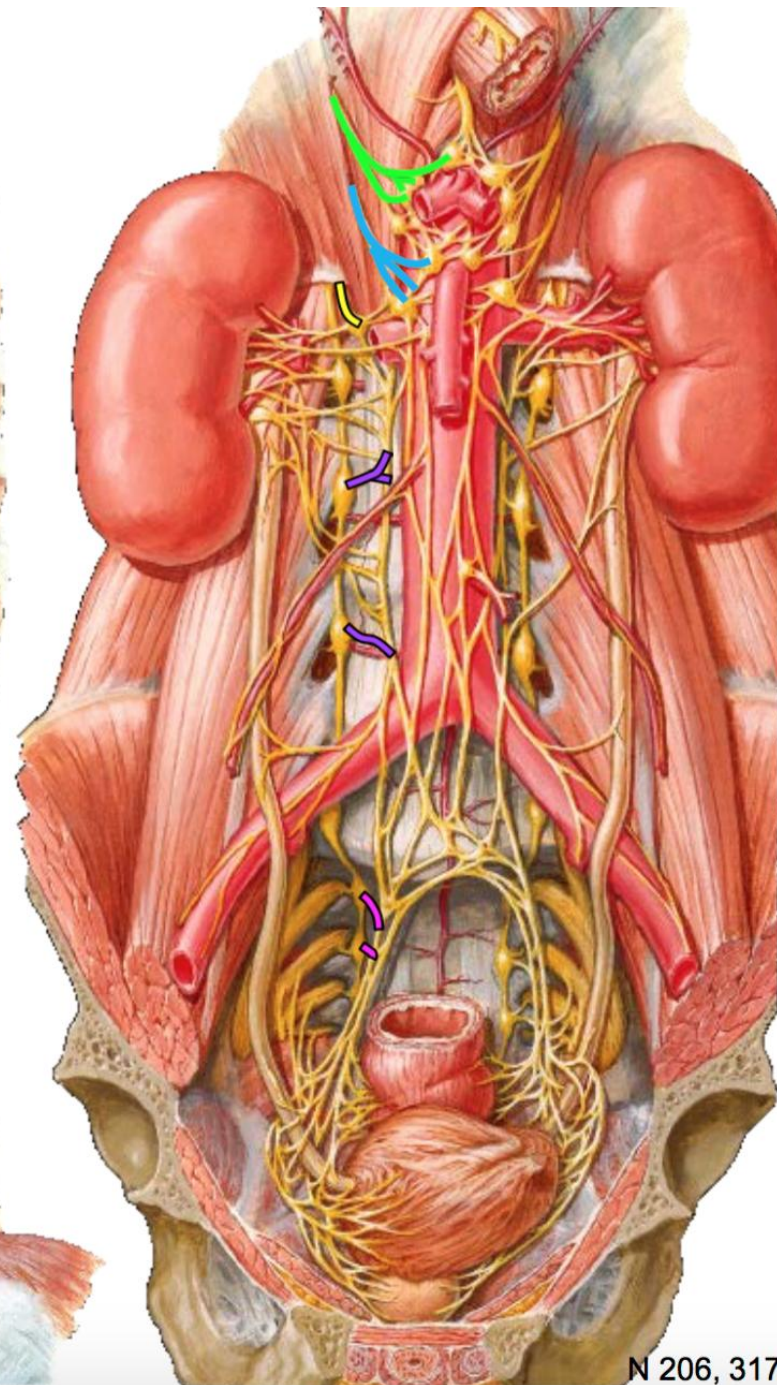
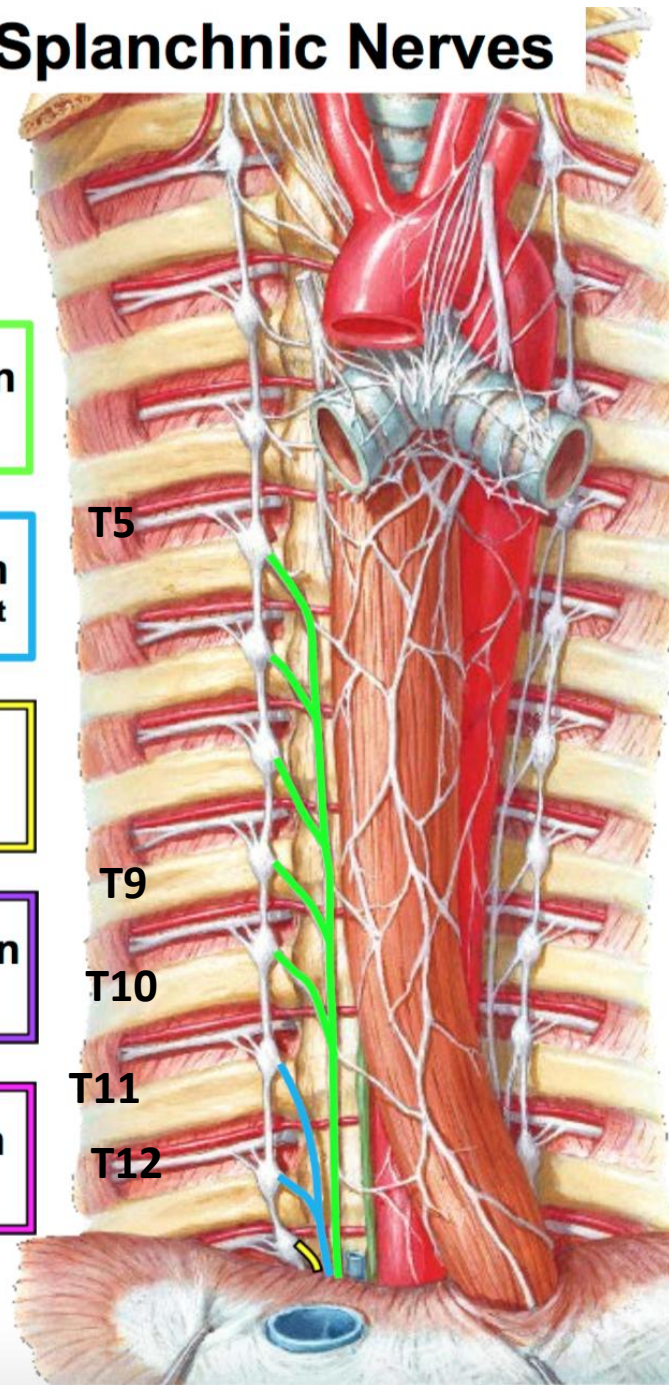
Greater splanchnic n
T5-T9 spinal cord segment

Lesser splanchnic n
T10-T11 spinal cord segment

Least splanchnic n
T12 spinal cord segment

Lumbar splanchnic n
L1-L2 spinal cord segment

Sacral splanchnic n
L1-L2 spinal cord segment

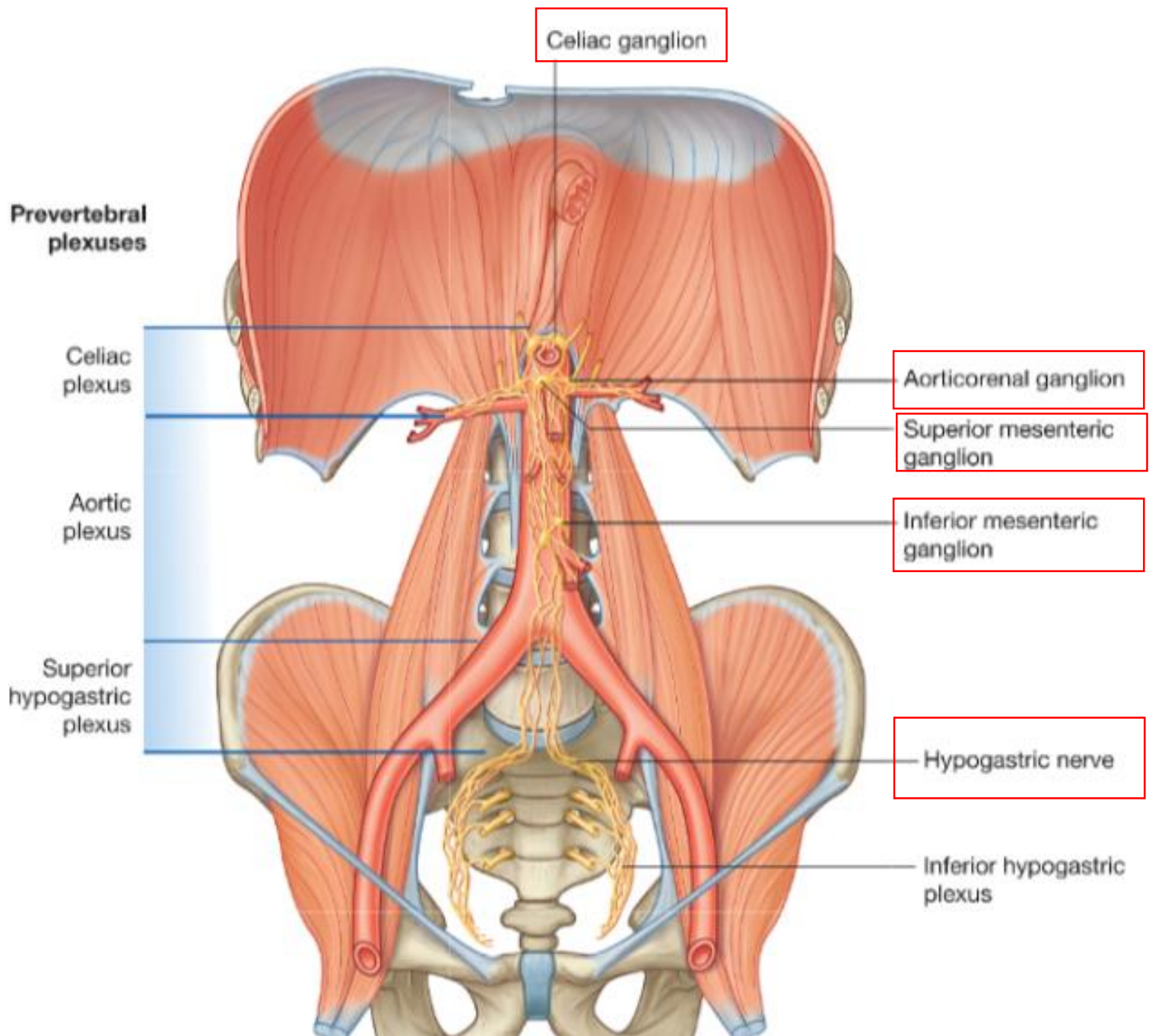


Abdominal Prevertebral Plexus and Ganglia

- The abdominal **prevertebral plexus** is a collection of nerve fibers that surrounds the abdominal aorta and is continuous onto its major branches forming **secondary plexuses**.
- The cell bodies of postganglionic sympathetic fibers are organized into distinct **ganglia** (prevertebral or preaortic ganglia) which are scattered throughout the length of the abdominal prevertebral plexus

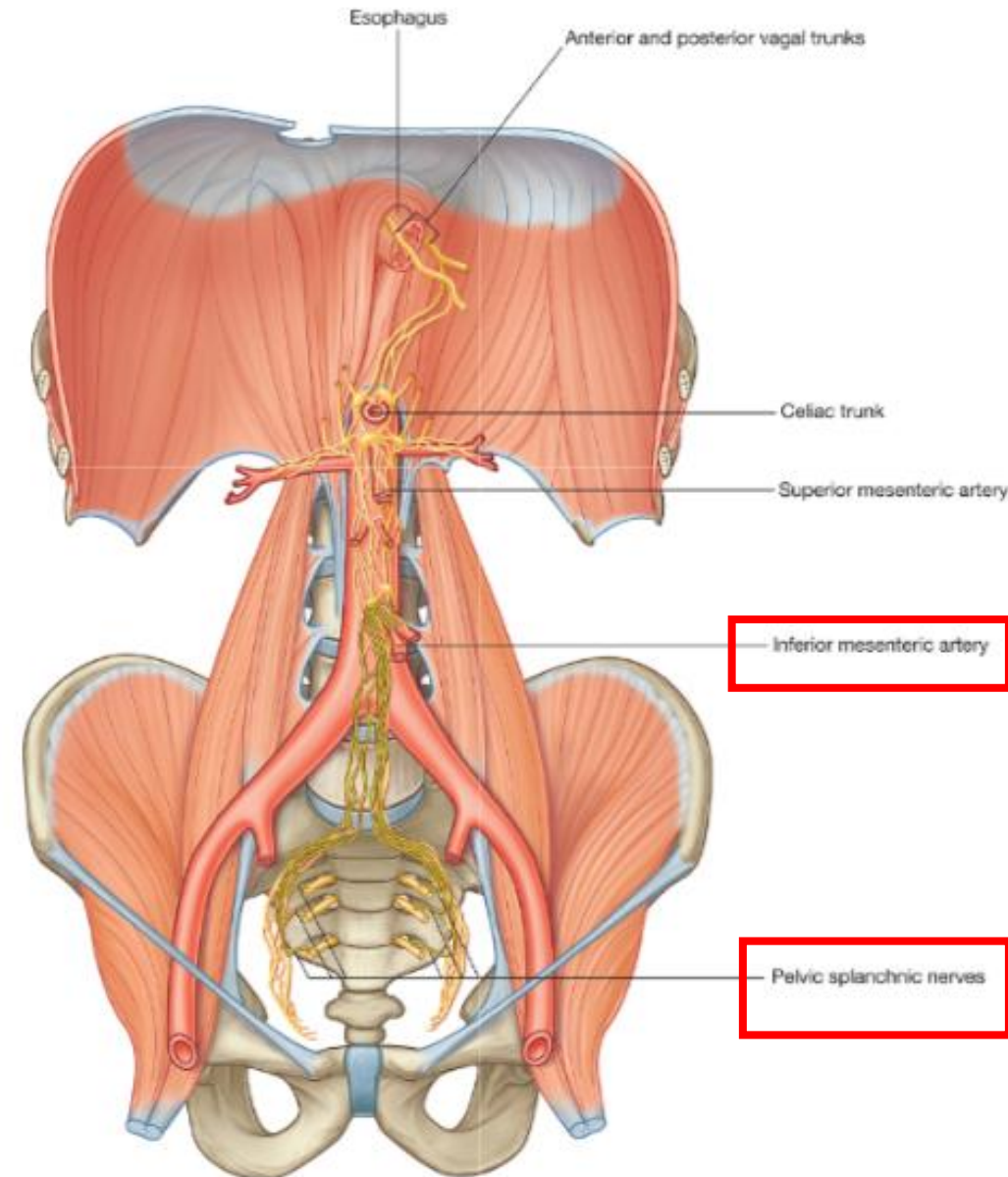
Abdominal Prevertebral Plexus and Ganglia

- The three major divisions of the abdominal prevertebral plexus and associated ganglia are:
 - 1. Celiac plexus:** associated with the roots of the celiac trunk and superior mesenteric artery immediately below the aortic hiatus of the diaphragm, the ganglia associated with the celiac plexus include **two celiac ganglia**, a **single superior mesenteric ganglion**, and **two aorticorenal ganglia**.
 - 2. Aortic plexus:** on the anterior and lateral surfaces of the abdominal aorta extending from just below the origin of the superior mesenteric artery to the bifurcation of the aorta into the two common iliac arteries, the major ganglion in this plexus is the **inferior mesenteric ganglion** at the root of the inferior mesenteric artery.
 - 3. Superior hypogastric plexus:** contains **numerous small ganglia** and is the final part of the abdominal prevertebral plexus before the prevertebral plexus continues into the pelvic cavity.



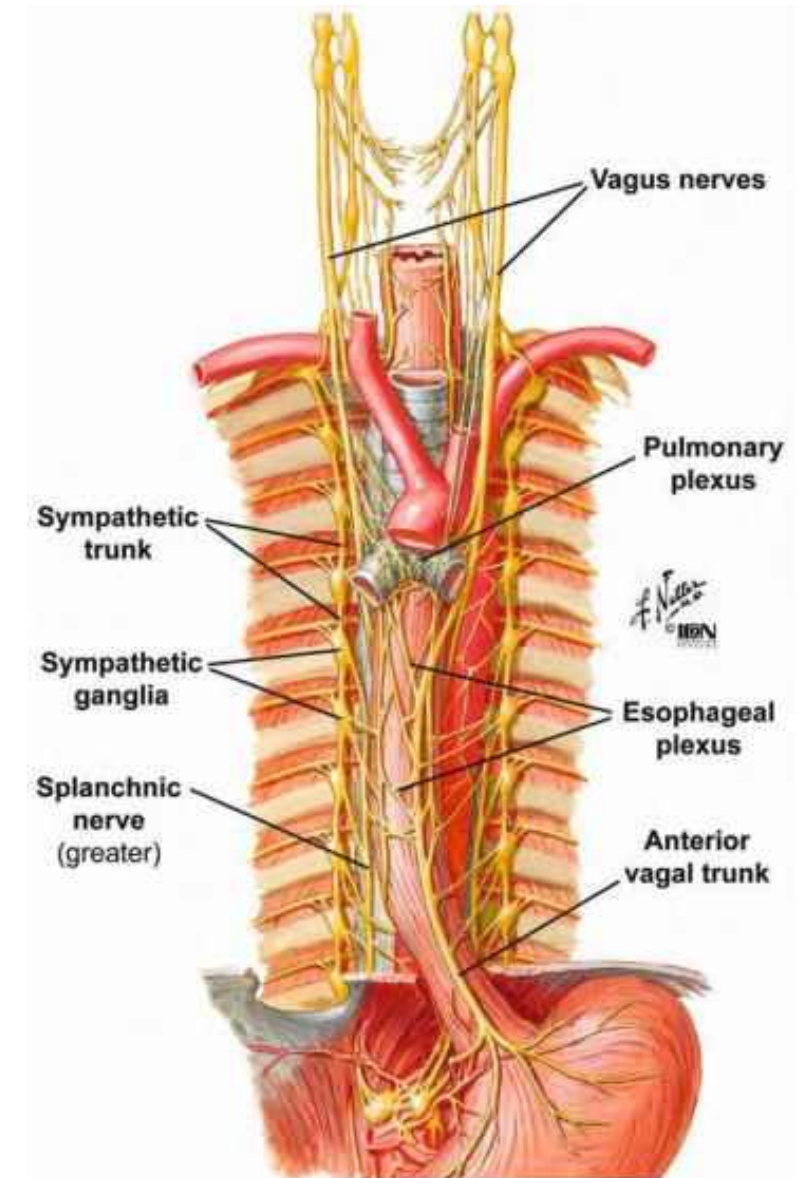
Parasympathetic Innervation- Pelvic Splanchnic Nerves

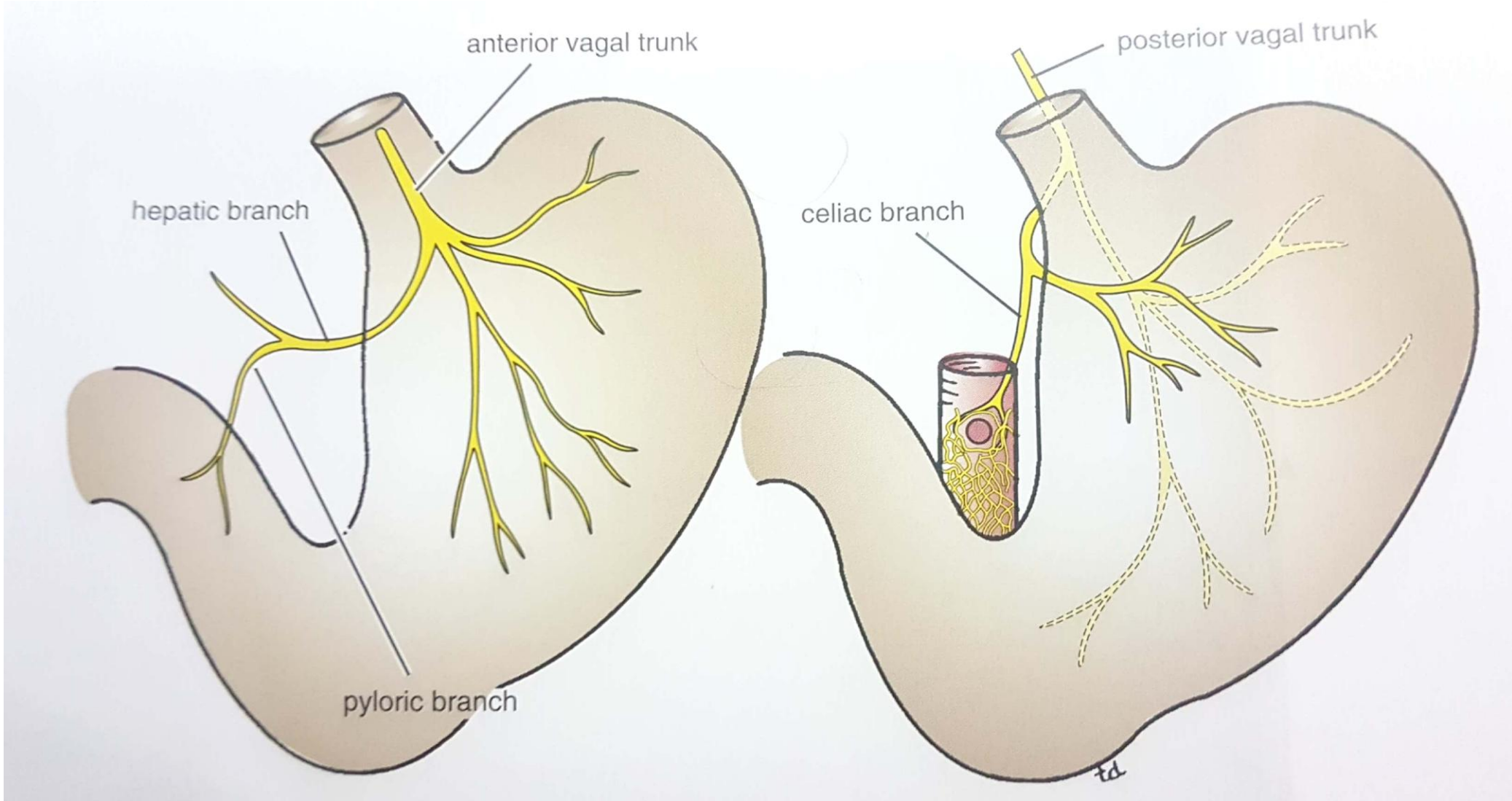
- **Pelvic splanchnic nerves** are **the only splanchnic nerves that carry parasympathetic fibers**
- Provide the pathway for innervation of the **distal one-third of the transverse colon, the descending colon, and the sigmoid colon (hindgut)** by preganglionic parasympathetic fibers
- The preganglionic parasympathetic fibers originating **from the S2 to S4 spinal nerves** to the **inferior hypogastric plexus** >>> Some fibers pass upward, enter the abdominal prevertebral plexus, and distribute with the branches of the **inferior mesenteric artery** supplying the hindgut.



Parasympathetic Innervation- Vagus Nerves

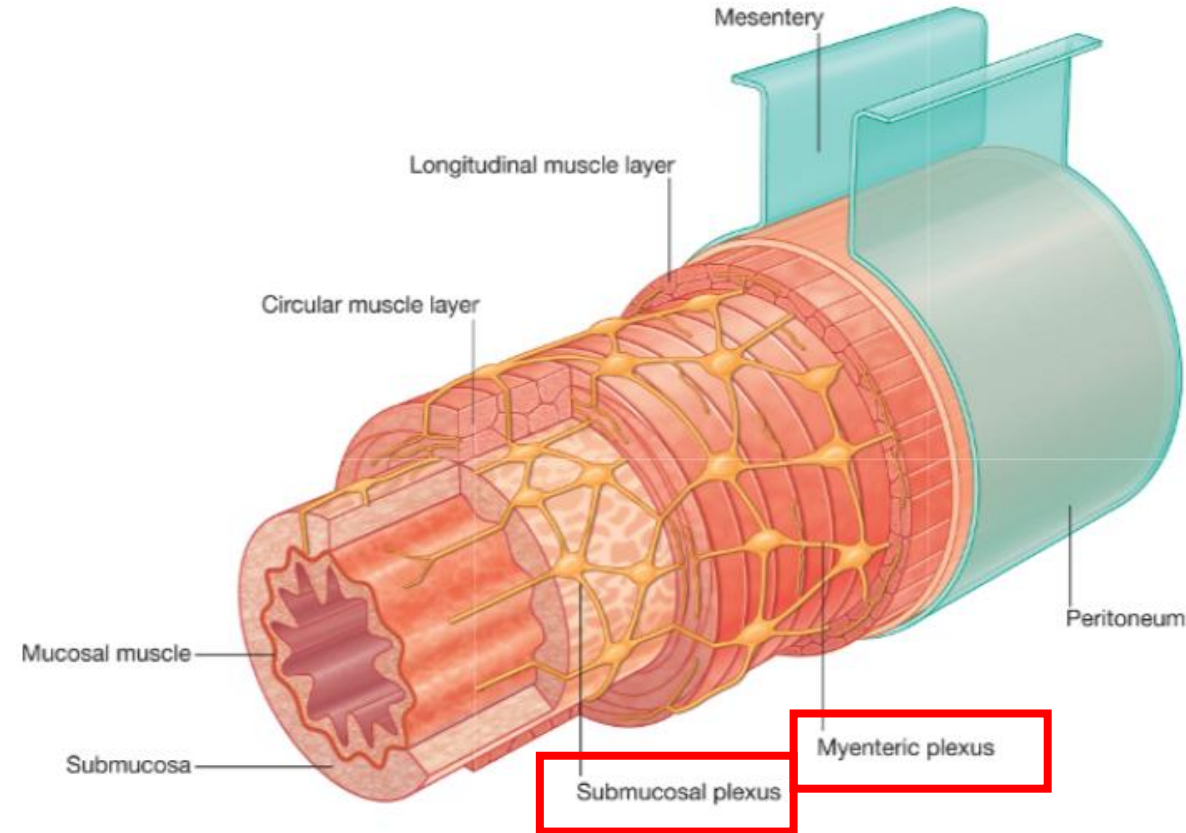
- Enter the abdomen associated with the esophagus as the esophagus passes through the diaphragm
- Provide parasympathetic innervation to the **foregut** and **midgut**.
- After entering the abdomen as the **anterior** and **posterior vagal trunks**, they send branches to the abdominal prevertebral plexus. These branches contain **preganglionic parasympathetic fibers** and **visceral afferent fibers**, which are distributed with the other components of the prevertebral plexus along the branches of the abdominal aorta (celiac trunk and superior mesenteric artery).





Intrinsic innervation (The Enteric System)

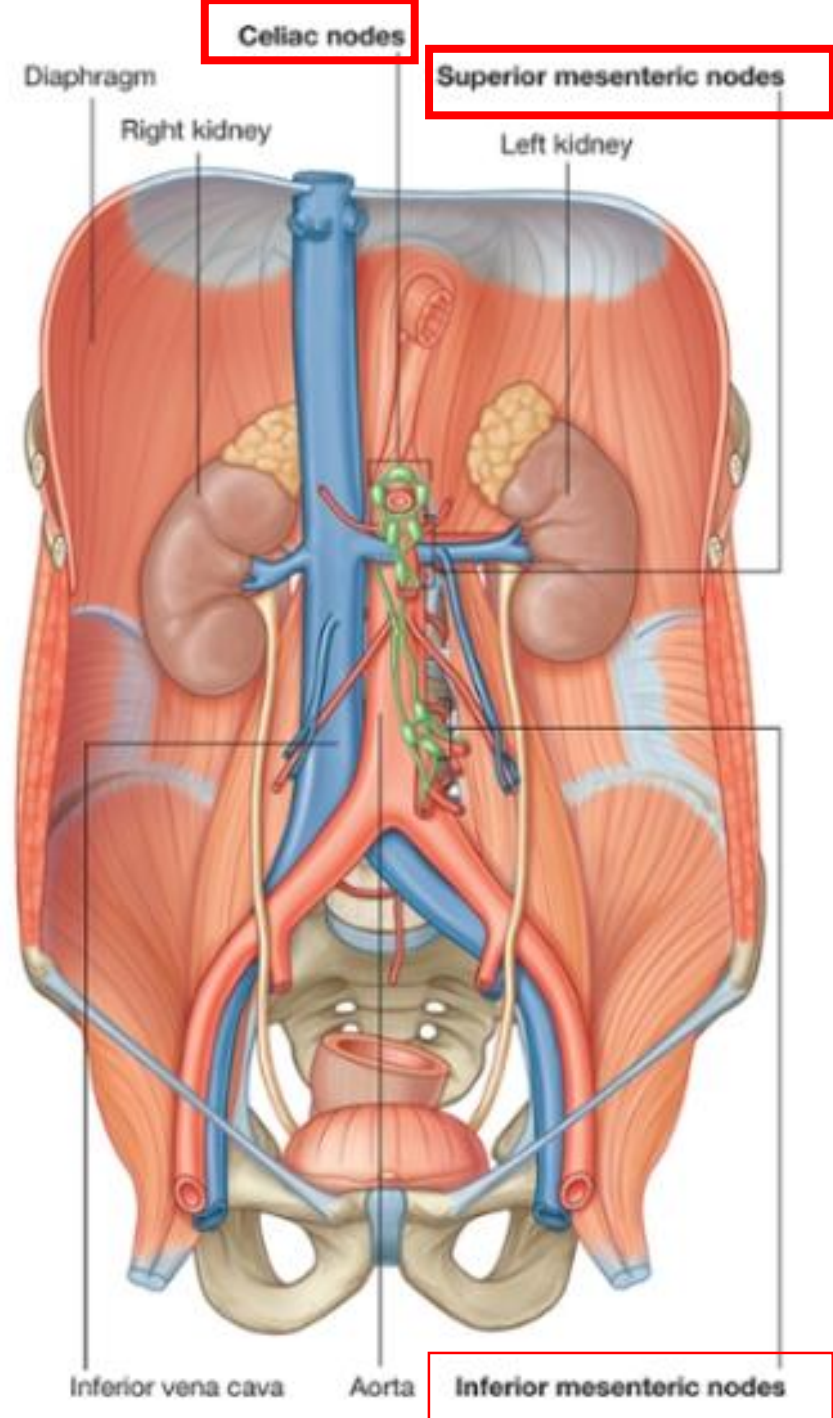
- Local neuronal circuit in the wall of the gastrointestinal tract
- It consists of motor and sensory neurons organized into two interconnected plexuses the **myenteric (Auerbach's)** plexus and **submucosal** (Meissner's) plexus between the layers of the gastrointestinal wall.
- The enteric system regulates and coordinates numerous gastrointestinal tract activities, including gastric secretory activity, gastrointestinal blood flow, and the contraction and relaxation cycles of smooth muscle (**peristalsis**).
- Although the enteric system is generally independent of the central nervous system, it does receive input from postganglionic sympathetic and preganglionic parasympathetic neurons that modifies its activities.

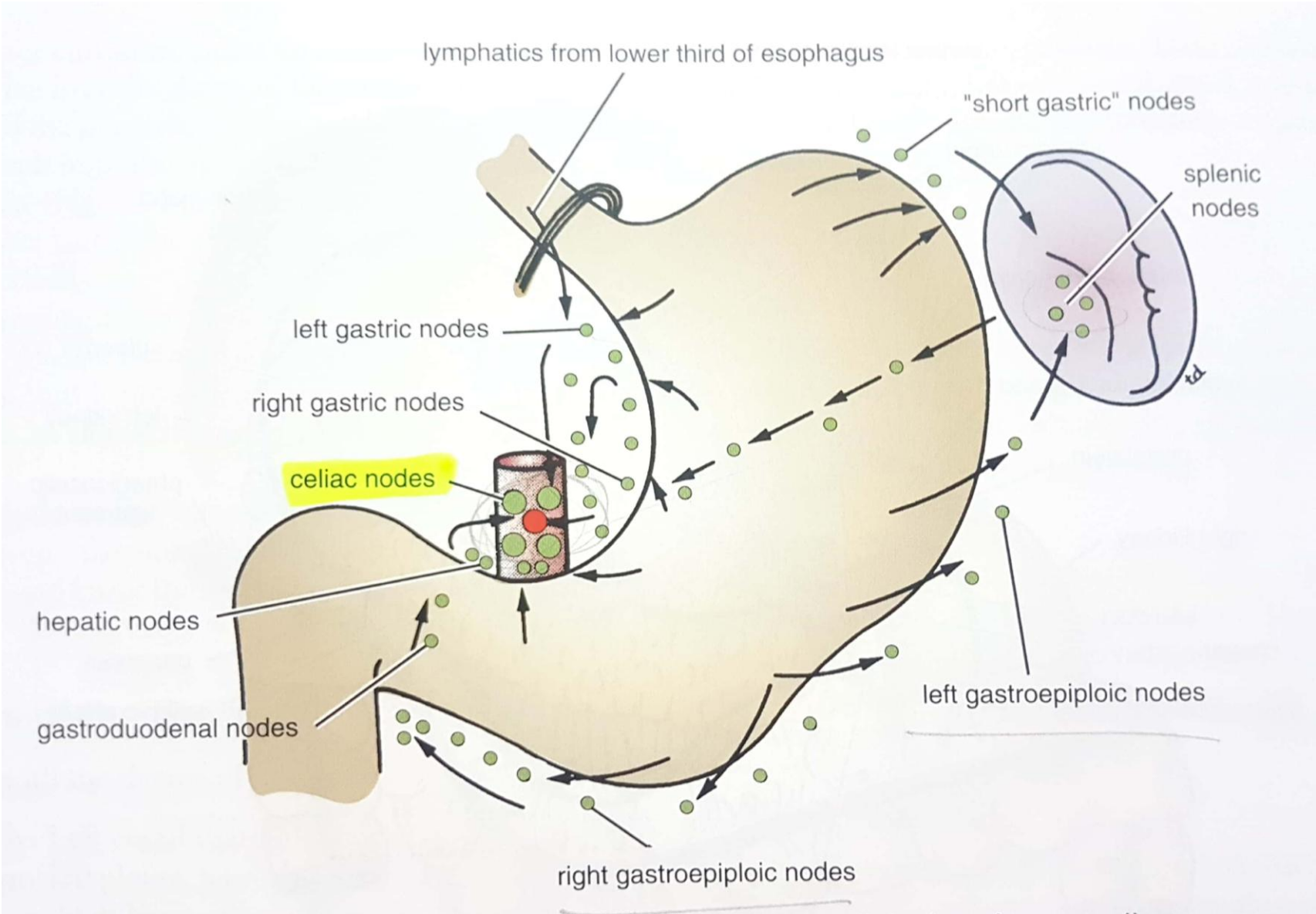


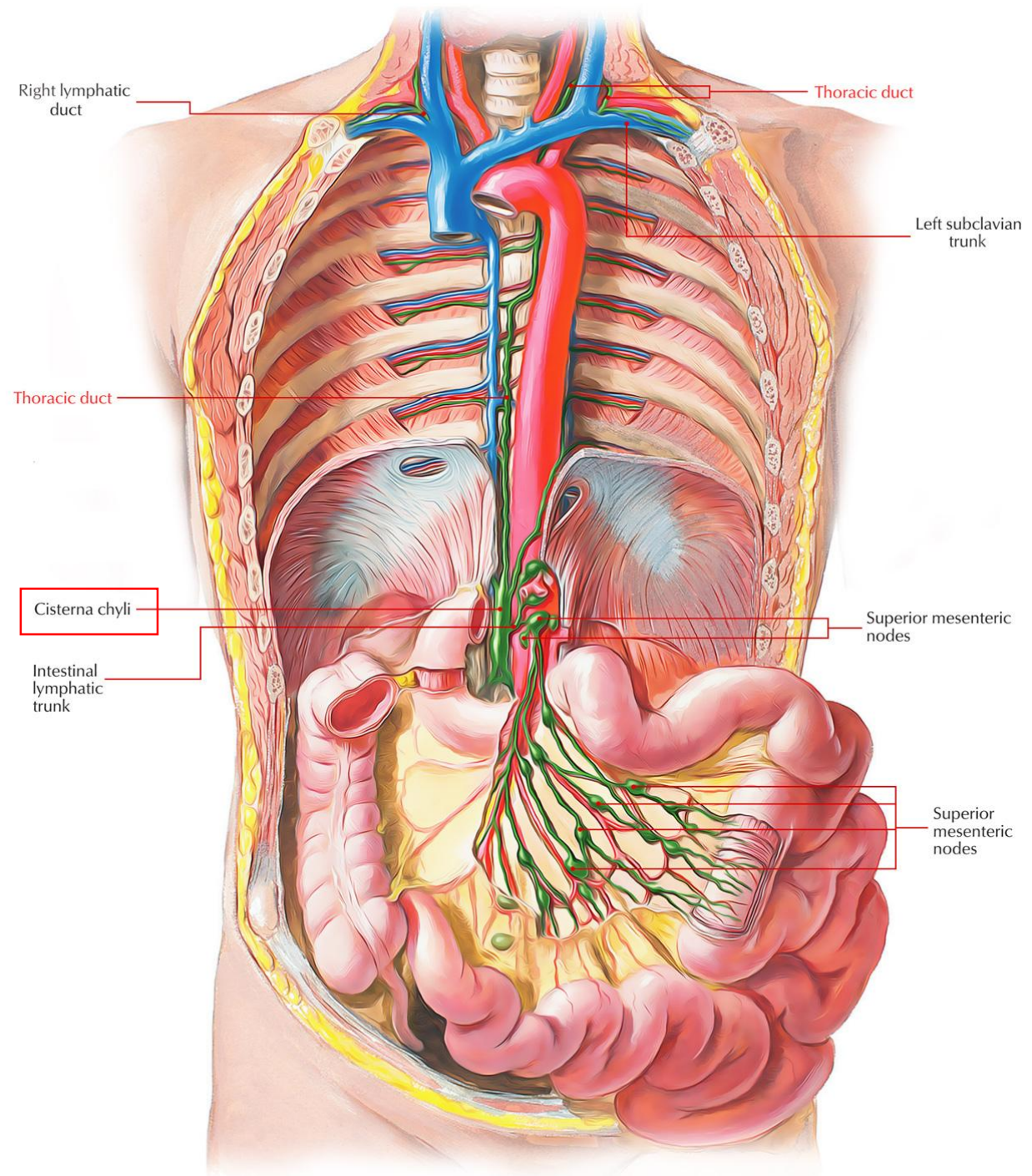
Lymphatics of GIT

Lymphatics of GI

- The lymph vessels and nodes of GI tract, spleen, pancreas, gallbladder, and liver follow the arteries that supply these structures
- Lymph vessels drain into large collections of **pre-aortic lymph nodes** at the origins of the three anterior branches of aorta which supply these structures. These collections are:
 - 1. Celiac nodes:** for structures that are part of the abdominal foregut, and from the superior and inferior mesenteric nodes >>> lymph from the celiac nodes enters the **cisterna chyli**
 - 2. Superior mesenteric nodes:** for structures that are part of the abdominal midgut, and from the inferior mesenteric nodes
 - 3. Inferior mesenteric nodes:** for the structures that are part of the abdominal hindgut, lymph from these nodes drains to the **superior mesenteric nodes**.







Thank you

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