

Pattern of Innervation of the Viscera

The nerves supplying the viscera are derived from the autonomic nervous system – sympathetic and parasympathetic.

The viscera of the thorax, abdomen and pelvis are supplied segmentally by branches of the sympathetic chain, and branches of the vagus nerve, as discussed below. The autonomic supply of structures in the head and neck follows a specific pattern that will be dealt with separately.

The **sympathetic chain:**

- Communicates with the spinal nerves via white and grey rami communicantes

The **white rami communicantes:**

- are present only at the levels of T1 to L2 spinal nerves
- convey all the sympathetic efferents from the spinal cord to the sympathetic chain
- consist of myelinated pre-ganglionic axons
- have their cell bodies in the lateral grey column of the spinal cord
- synapse in the sympathetic ganglia with postganglionic neurons

NOTE: The cervical, lower lumbar and sacral ganglia have no white rami, and receive their sympathetic inflow from the thoracic and lumbar segments via ascending or descending axons in the sympathetic chain

The **grey rami communicantes**

- consist of unmyelinated postganglionic neurons
- are the axons of postganglionic neurons
- distribute **somatic branches** via the cutaneous nerves to the arteries, sweat glands and arrectores pilorum in the skin, (where they are vasoconstrictor, secretomotor, and pilomotor respectively).
- are present in all spinal ganglia

Visceral sympathetic branches

- are distributed to the viscera via **autonomic nerve plexuses** (listed in the table below)
- arise as direct branches from the sympathetic ganglia *(Those arising from T5 to T12 ganglia are the greater, lesser and least splanchnic nerves)*
- are pre-ganglionic myelinated axons (they do not synapse in the sympathetic ganglia)
- synapse in ganglia associated with the autonomic nerve plexuses
- enter the viscera as plexuses in the adventitia of arteries to the viscera

Autonomic nerve plexuses and their respective ganglia

- are mixed plexuses containing also parasympathetic nerves
- are situated around the origins of the arteries supplying the organs
- receive direct branches from the sympathetic ganglia

The various autonomic plexuses and the sympathetic segments from which they arise are summarized in the table below

Plexus	Origin	Location	Supply
Cardiac plexuses (superficial and deep)	Superior, middle & inferior cervical ganglia	Inferior and posterior to aortic arch	Heart: SA & AV nodes via coronary arteries
Pulmonary plexuses	Upper 4 thoracic ganglia	Hilum of each lung	Bronchial tree
Oesophageal plexus	Upper 4 thoracic ganglia	Around oesophagus	Thoracic oesophagus
Coeliac plexus	Greater splanchnic nerve (T5-T9)	Around coeliac axis	Foregut derivatives-
Superior mesenteric plexus	Lesser & least splanchnic nerves (T9-T12)	Around superior mesenteric artery	Midgut derivatives
Renal plexus	Least splanchnic nerve (T11-12)	Around renal arteries	Renal blood vessels
Inferior mesenteric	Superior hypogastric plexus (lumbar ganglia)	Around inferior mesenteric artery	Hindgut derivatives
Inferior hypogastric plexus	Lumbar and sacral ganglia	Below common iliac arteries	Pelvic viscera

Table 1: Autonomic plexuses of the thoracic and abdominal viscera.

Parasympathetic Innervation of the Thoracic and Abdominal Viscera

The parasympathetic innervation of the viscera of the head and neck will be dealt with elsewhere.

The parasympathetic innervation to the thoracic and abdominal viscera is derived from:

1. The **vagus nerves**

- supply thoracic and most abdominal viscera
- pass:
 - **anterior** to the subclavian arteries
 - **lateral** to the left common carotid artery and arch of the aorta on the left, and lateral to the trachea on the right
 - **posterior** to the hilum of the lung
- form a plexus on the oesophagus
- form anterior and posterior vagal trunks (derived mainly from the left and right vagus nerves respectively)
- give branches to the autonomic plexuses: cervical branches to the cardiac and pulmonary plexuses; vagal trunks to the coeliac, aortic and superior hypogastric plexuses.
- are pre-ganglionic parasympathetic axons
- synapse with post-ganglionic neurons within the viscera (ganglia of the submucosal (Auerbach's) and myenteric (Meissner's) plexuses in the gut)

2. The **pelvic splanchnic nerves**:

- emerge from S2,3 and 4 spinal nerves
- have their cell bodies in the lateral grey column of the S2-4 spinal cord
- join the hypogastric plexus
- supply the pelvic viscera, distal one-third of the transverse colon, descending colon, sigmoid colon and rectum
- like the vagus nerves are pre-ganglionic parasympathetic and synapse with post-ganglionic neurons within the viscera

Figure 1. Autonomic innervation of the heart, viscera and skin in (a) cervical and (b) thoracic levels

