The autonomic nervous system (physiology)

The autonomic nervous system (ANS) (also known as the **autonomic nervous system** , ANS) is part of the peripheral nervous system together with the somatic efferent (motor) system (carrying impulses from the CNS to the will-controlled striated muscles) and sensory (afferent) fibers (conducting sensation and pain). VNS ensures the transfer of impulses between the central nervous system (CNS) and effector tissues **independent of volitional control** (smooth muscle , myocardium, exocrine glands...).

The vegetative nervous system is divided into **motor (efferent)** and **sensory (afferent) parts** . Although afferent fibers play an important role in the regulation of homeostasis (e.g. cholinergic fibers from baroreceptors in the *glomus caroticum*), they are pharmacologically affected by a minimum of drugs. Attention is therefore focused on the study of the efferent part. It anatomically consists of 2 systems - sympathetic and parasympathetic . A somewhat separate unit is the **enteric nervous system (ENS)** , which, because of its relative independence from other parts of the VNS, is often singled out as an independent third part of the VNS with a specific function in the control of function gastrointestinal tract.

ANS anatomy

The efferent (motor) pathways of the ANS consist of 2 neurons , which are interpolated in the *vegetative ganglia* – *preganglionic* and *postganglionic* neurons are distinguished according to their position . There are significant differences in the arrangement of these pathways between the sympathetic and parasympathetic.

Sympathicus

The bodies of the sympathetic preganglionic neurons are located in the lateral corners of the gray matter of the spinal cord in the area of the thoracic and lumbar segments (Th1-L3). The axons of these neurons leave the spinal cord in the corresponding segments, therefore the sympathetic system is referred to as the *thoraco-lumbar* system . The sympathetic autonomic ganglia are well organized and form two paravertebral chains along the spine. Excitations to the abdominal and pelvic organs are interpolated in ganglia located prevertebrally. It follows from the above that the axons of preganglionic neurons are much shorter than the axons of postganglionic neurons.

Parasympathicus

The preganglionic fibers of the parasympathetic leave the CNS via some cranial nerves(n. III, VII, IX and X) and the anterior horns of the spinal cord in the area of the sacral segments (S2–S4) – the parasympathetic is therefore referred to as *the cranio-sacral* system. Vegetative parasympathetic ganglia are located mainly in the wall of effector organs, preganglionic fibers are therefore much longer than axons of postganglionic neurons. With exceptions (ggl. cilliare, submandibulare and pelvic ganglia), parasympathetic ganglia are not precisely organized and the connections between pre- and postganglionic neurons are rather diffusely scattered in the wall of the effector organs.

🔎 *For more information see Autonomic nervous system (anatomy).*

ANS mediators

Noradrenaline is a mediator on most **postganglionic sympathetic fibers.**

Acetylcholine acts as a mediator on all **preganglionic ANS fibers**, all **postganglionic parasympathetic fibers** and some sympathetic postganglionic fibers (e.g. sweat glands). Acetylcholine is also used as a mediator in the adrenal medulla, where its cells developmentally correspond to the sympathetic ganglion and are therefore innervated by preganglionic sympathetic fibers. The cells themselves release adrenaline after stimulation.

According to mediators, ANS fibers are divided into **adrenergic** and **cholinergic** .

ANS function

Table 1 offers an overview of the basic functions that are influenced by the vegetative nervous system. Most of the tissues controlled by the ANS receive innervation from both the parasympathetic and sympathetic nerves, which usually act in opposition to each other. However, the influence of one system in a given tissue usually prevails – for example, blood vessels are primarily under the influence of the sympathetic, GIT and SA node under the influence of the parasympathetic.

Table 1 – Main functions of ANS

Organ	Sympathetic		Parasympathetic	
	Answer	**Receptor**	**Odpověď**	**Answer**
Heart				
SA node	acceleration	β_1	slowdown	M_2
atrial muscle	↑ contractility	β_1	↓ contractility	M_2
AV uzel	↑ automaticity	β_1	↓ conduction speed	M_2
ventricular muscle	↑ automaticity ↑ contractility	β_1	↓ automaticity ↓contractility	M_2
SMOOTH MUSCLE VESSELS				
skin, mucous membranes, internal organs	constriction	α_1, α_2	vasodilation (negligible)	M3
skeletal muscle	dilatation	β_2	vasoconstriction	indirectly
LUNG				
muscles of the trachea and bronchi	relaxation	β_2	contraction	
secretion of bronchial glands	inhibition		stimulation	M_3
GIT				
muscle	relaxation, ↓ motility	α_2, β_2	↑ tone, motility	M_3
sphincter	contraction	α_1	relaxation	M_3
	relaxation	β_2		
UROGENITAL TRACT				
m. detrusor	relaxation	β_2	contraction	M_3
sphincter	contraction	α_1	relaxation	M_3
EYE				
intraocular pressure	increase		reduction	
m. dilator pupilae	mydriasis	α_1	---	
m. sphincter pupilae	---		miosa	M_3
m. ciliaris	remote accommodation	β_2	accommodation nearby	M_3
GLANDS				
salivary	weak stimulation of secretion	α_1	strong generalized secretion||M_3	
tearful	weak stimulation of secretion	α_1	strong secretion	
other				
Womb	relaxation	β_2	variable	
Man. subject org.	ejaculation	α_1	erection	
Liver	glycogenolysis,, gluconeogenesis	β_2		
Fat bb	lipolysis	β_2, β_3		

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Sources

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