

The Autonomic Nervous System

The autonomic nervous system consists of nerves that connect the CNS to organs and other structures such as the heart, stomach, intestines, glands, blood vessels, and bladder (among others). The autonomic nervous system controls organs not under voluntary control, so it is often referred to as the “involuntary” nervous system.

Division of autonomic nervous system

The two divisions of the autonomic nervous system are

1.the sympathetic (thoracolumbar) division

The sympathetic division prepares organs for “fight-orflight” situations. In other words, it prepares them for stressful or emergency situations. For example, the sympathetic division prepares the heart for a stressful or frightening situation by increasing the heart rate.

2.the parasympathetic(craniosacral) division

The parasympathetic division prepares the body for resting and digesting. For example, the parasympathetic division prepares the heart for resting by keeping the heart rate relatively low.

Both systems have efferent pathways through peripheral ganglia; these ganglia serve as synaptic relay stations, accordingly we have presynaptic and postsynaptic neurons .

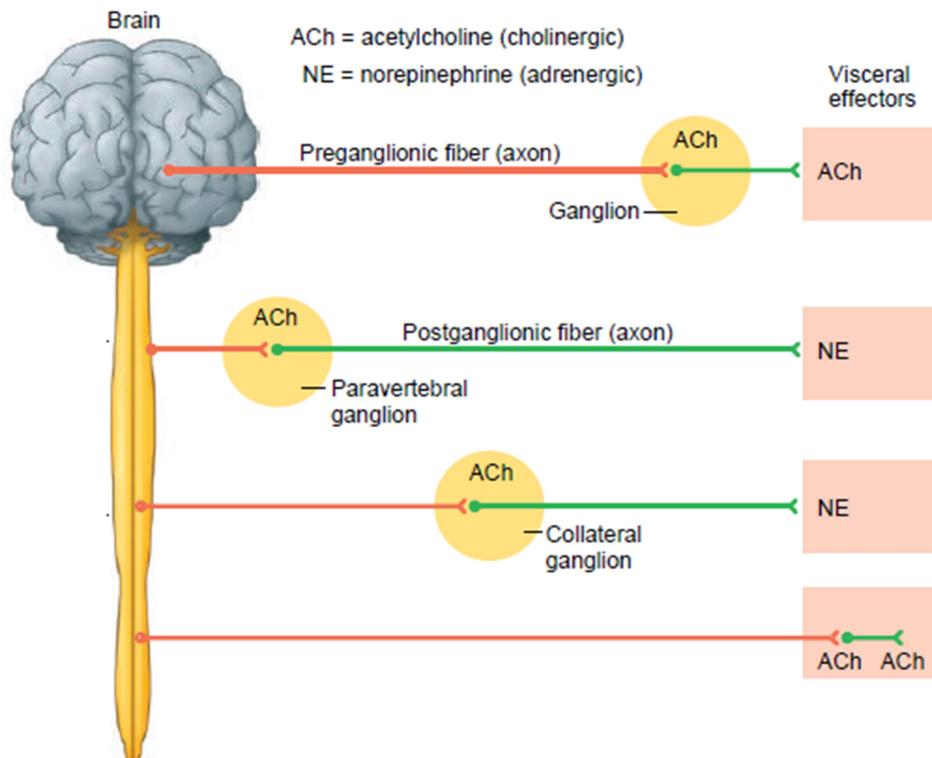


Figure:Divisions of the Peripheral Autonomic System

Notice: that sympathetic and parasympathetic actions are antagonistic, meaning that they function in opposite ways.

AUTONOMIC NEUROTRANSMITTERS

The two main neurotransmitters of autonomic nervous system are, acetylcholine and norepinephrine,

(1).Acetylcholine is the transmitter released at preganglionic synapses in both parasympathetic and sympathetic ganglia, parasympathetic postganglionic neuroeffector . Neurons that release acetylcholine are called cholinergic neurons. Drugs that mimic the actions of acetylcholine are termed cholinomimetic also called parasympathomimetic drugs. Drugs that antagonize the actions of acetylcholine are known as cholinoreceptor antagonists. The receptors with which acetylcholine and other cholinomimetic drugs interact are called cholinergic receptor . There are two types of Cholinoceptors:

- 1.Muscarinic (M-)cholinoceptors
2. Nicotinic cholinoceptors,

(2).Norepinephrine is the transmitter released at most sympathetic postganglionic neuroeffector junctions. Drugs that mimic the actions of epinephrine and/or norepinephrine are adrenomimetic also called sympathomimetic. Drugs that antagonize the actions of norepinephrine are known as adrenoceptor antagonists. The receptors with which norepinephrine, epinephrine, are called adrenergic receptor(ARs).

The ARs divided into two distinct groups:

1. α receptors , which further subdivided into : α -ARs included α 1 and α 2
2. β receptors , which further subdivided into β 1, β 2 and β 3-ARs

Sympathetic Responses

During physical or emotional stress, the sympathetic division dominates the parasympathetic division. Activation of the sympathetic division and release of hormones by the adrenal medullae set in motion a series of physiological responses collectively called the **fight-or-flight** response, which includes the following effects:

- The pupils of the eyes dilate.
- Heart rate, force of heart contraction, and blood pressure increase.
- The airways dilate, allowing faster movement of air into and out of the lungs.

- The blood vessels that supply the kidneys and gastrointestinal tract constrict.
- Blood vessels that supply ,skeletal muscles, cardiac muscle, liver, and adipose tissue—dilate, allowing greater blood flow through these tissues.
- Liver cells perform glycogenolysis (breakdown of glycogen to glucose), and adipose tissue cells perform lipolysis (breakdown of triglycerides to fatty acids and glycerol).
- Release of glucose by the liver increases blood glucose level.

Parasympathetic Responses

In contrast to the fight-or-flight activities of the sympathetic division, the parasympathetic division enhances rest and digest activities.

The parasympathetic responses include

- salivation
- lacrimation
- urination
- digestion
- defecation

All of these activities are stimulated mainly by the parasympathetic division. other important parasympathetic responses are “three decreases”: decreased heart rate, decreased diameter of airways (bronchoconstriction), and decreased diameter (constriction) of the pupils.

The electroencephalogram (EEG)

The electroencephalogram (EEG) records electrical activity of the cerebral cortex via electrodes placed on the skull. In normal healthy people, most waves in the EEG can be classified as alpha, beta, theta, and delta waves with variable frequency (Hz, or cycles per second) and amplitude(μV):

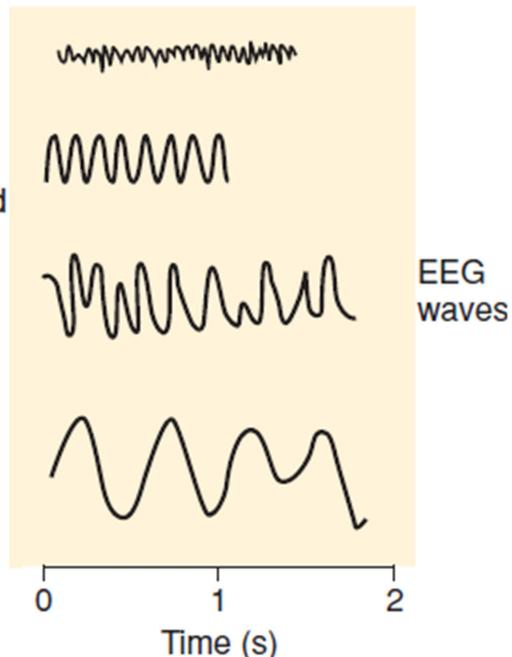
- Alpha waves are rhythmical waves that occur at frequencies between 8 and 13 cycles per second and amplitude of 50-100 μV
- Beta waves occur at frequencies greater than 14 cycles per second and as high as 80 cycles per second. Recorded while a person is experiencing visual and mental activity.
- Theta waves have frequencies between 4 and 7 cycles per second. They occur normally in the parietal and temporal regions in children, but they also occur during emotional stress in some adults, and degenerative brain states.
- Delta waves include all the waves of the EEG with frequencies less than 3.5 cycles per second. They occur in very deep sleep, in infancy, and in serious organic brain disease.

Beta (β) 13–30 Hz
awake, alert, eyes open

Alpha (α) 8–13 Hz
awake, relaxed, eyes closed

Theta (θ) 4–8 Hz

Delta (δ) 0.5–4 Hz



Sleep

Sleep is defined as unconsciousness from which the person can be aroused by sensory or other stimuli. There are two types of sleep: rapid eye movement (REM) sleep and non-REM (NREM) sleep.

(1).Non- rapid eye movement (NREM) sleep.

NREM sleep is characterized by a reduction in physiological activity. As sleep gets deeper, the brain waves as measured by EEG get slower and have greater amplitude, breathing and heart rate slow down, and blood pressure drops. The NREM phase occupies most of our sleep period and consists of four stages, the four NREM stages (stages 1, 2, 3, and 4) roughly parallel a depth-of sleep continuum.

(2) rapid eye movement sleep (REM sleep),

REM sleep, on the other hand, occurs in episodes that occupy about 25% of the sleep time in young adults; each episode normally recurs about every 90 minutes. REM Sleep marked by intense brain activity. In REM sleep most of dreams occur.

Sleep Disorder

- **Sleep Apnea**, a serious, potentially life-threatening disorder characterized by episodes of interrupted breathing during sleep. There are two types of sleep apnea- central and obstructive. Successful treatment, usually with nasal continuous positive airway pressure or CPAP.
- **Narcolepsy**, a chronic neurological disorder that causes the sufferer to fall asleep at times when he or she wants to be awake. In addition to an overwhelming and recurring need to sleep at inappropriate times.
- **Insomnia**, insomnia is the complaint of difficulty initiating or maintaining sleep, waking too early and not being able to get back to sleep, or waking feeling unrefreshed and lethargic

Epilepsy

Epilepsy (also called "seizures") is characterized by uncontrolled excessive activity of either part or all of the central nervous system. Epilepsy cause sudden, massive discharge of neurons (seizures) resulting in motor convulsions, sensory and psychic disturbances, and often impaired consciousness; may result from birth trauma, tumors, infections, drug or

alcohol abuse, or congenital brain malformation Epilepsy can be classified into three major types: grand mal epilepsy, petit mal epilepsy, and focal epilepsy.

Memory

Memory is the mechanism for storing what is learned. Memory also defined as the mental faculty of retaining and recalling past experiences, the act or instance of remembering recollection. Learning takes place when we retain and utilize past memories.

There are three basic types of memory:

1. Sensory Memory
2. Short Term Memory
3. Long Term Memory

Sensory Memory

In the sensory storage the stimulus is held for a fraction of a second. If the information has some meaning it will be moved to short-term memory. If it has no importance it will be dumped. A sensory memory retains an exact copy of what is seen or heard.

Short Term Memory (STM)

Short Term Memory last seconds to hours, it acts as a scratch pad for temporary recall of the information under process. After short –term memory loop is formed, the fate of information stored are

- The information kept in short term and used for short period
- The information converted into long term memory.
- The information lost.

Long-term memory(LTM) has a long duration and virtually limitless capacity.

Long-term memory last years or some time throughout the life, its of two main pattern

1.declarative, in this pattern of memory we store such pieces of information as our names, frequently used telephone numbers, recollections of prior experiences, general knowledge about the world, and things we've learned in school.

2. procedural, in this pattern of memory we store knowledge about how to perform various behaviors, such as how to ride a bicycle, swing a

baseball bat, such knowledge about how to do things is known as procedural knowledge.

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