Autonomic Nervous System

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Physiology Team 434
contact us : physiology434@gmail.com

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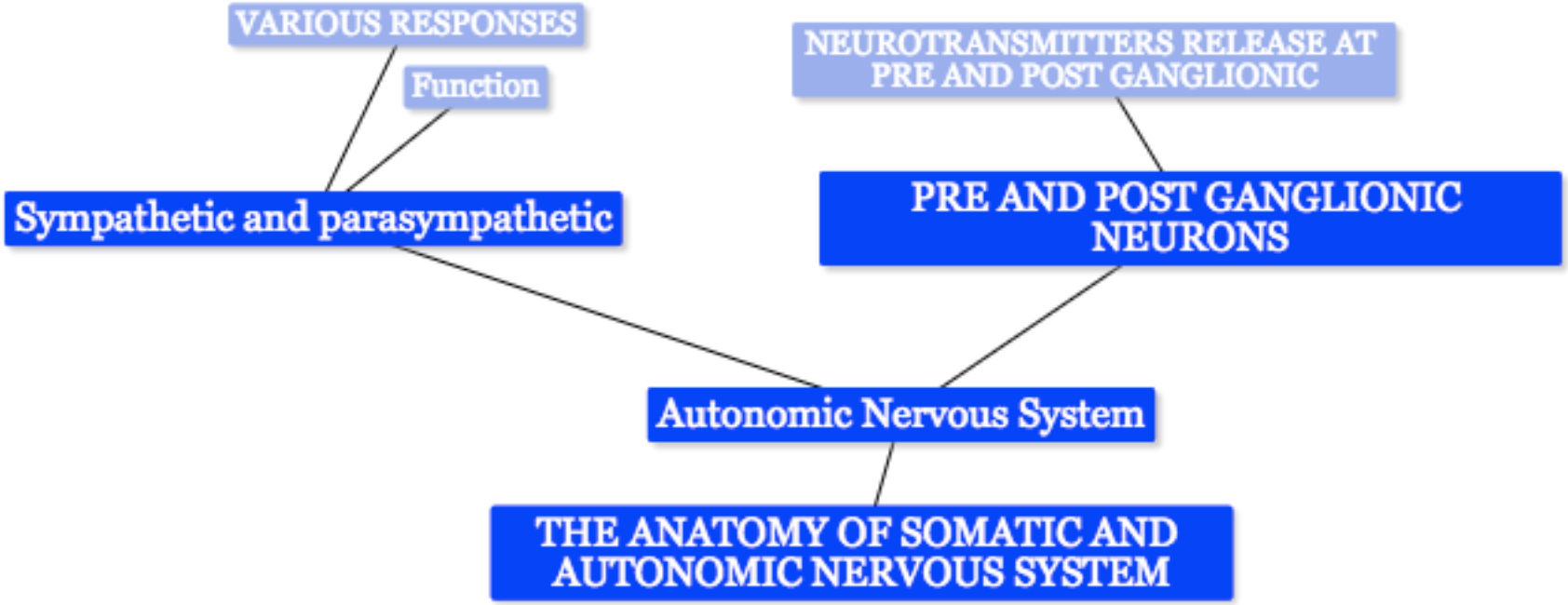
Mind map

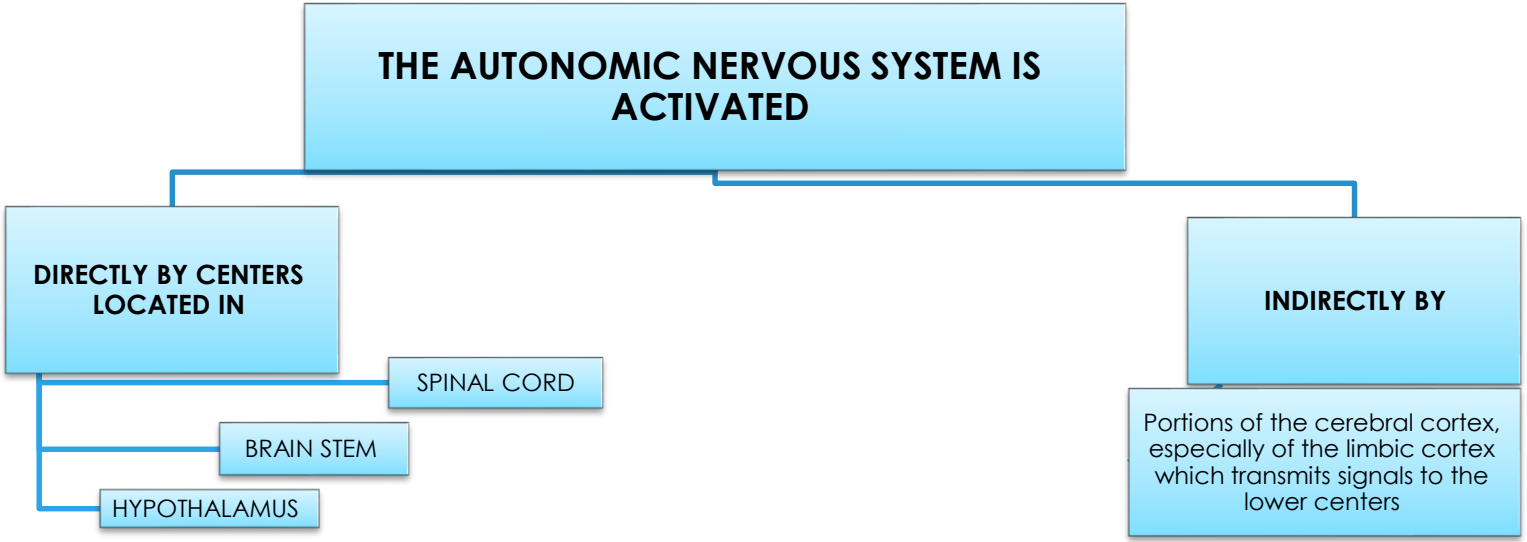


TERMINOLOGY:

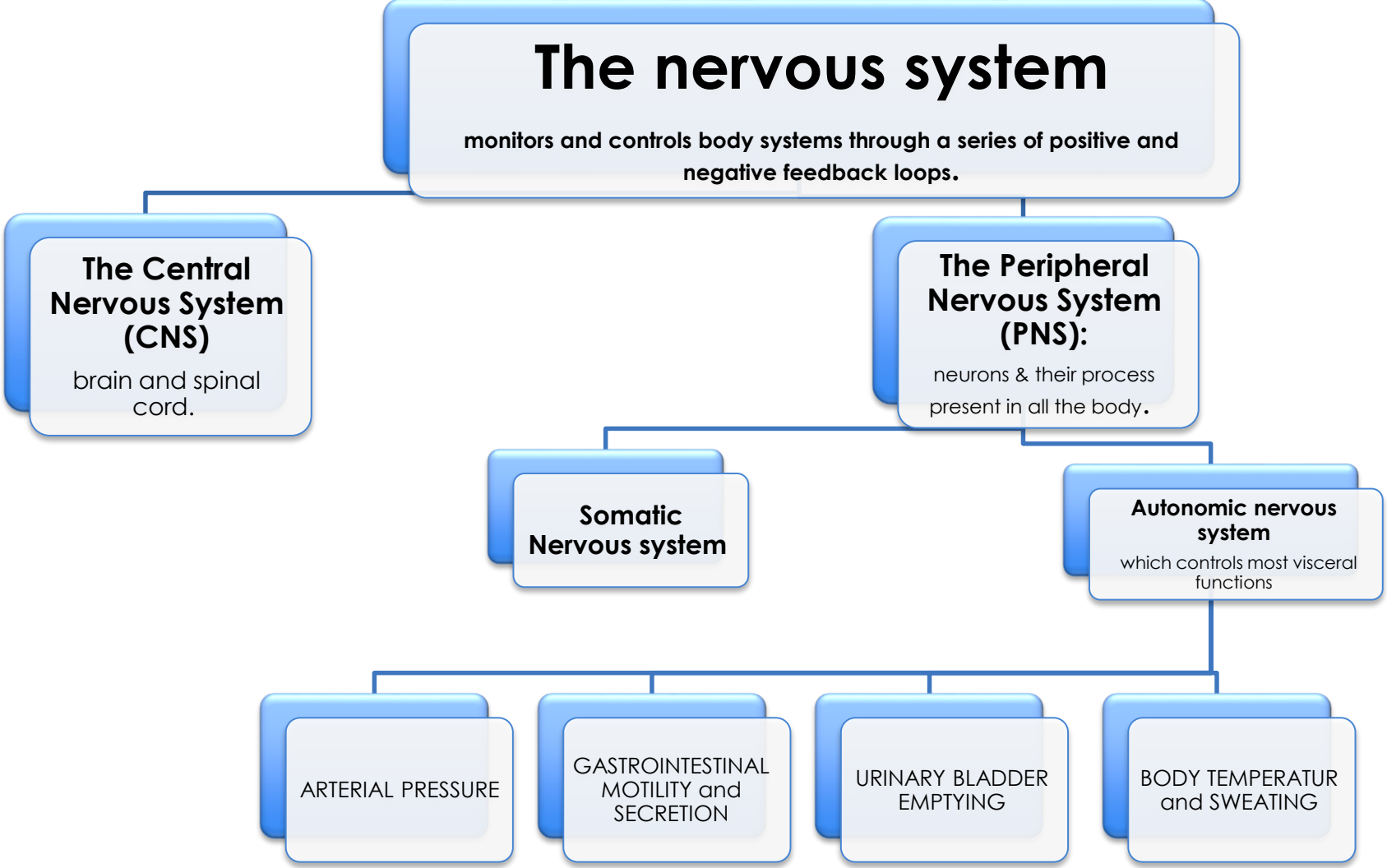
THORACOLUMBAR OUTFLOW, CRANIOSACRAL OUT FLOW

ALARM REACTION: FLIGHT OR FIGHT RESPONSE , CONSERVATION OF BODY ENERGY

GENERAL ORGANIZATION OF THE AUTONOMIC NERVOUS SYSTEM



- **The autonomic nervous system (ANS) is the part of the nervous system that is responsible for homeostasis**
- **It operates through visceral reflexes.**
- **Subconscious sensory signals from visceral organs can enter the autonomic ganglia, the brain stem, or the hypothalamus and the autonomic system then return subconscious reflex responses directly back to the visceral organs to control their activities**
- **Survival is possible without an ANS, but the ability to adapt to environmental stressors and other challenges is severely compromised .**
- **Many drugs used to treat many diseases exert their actions on elements of the ANS.**


The nervous system
monitors and controls body systems through a series of positive and negative feedback loops.
The Central Nervous System (CNS)
brain and spinal cord.
The Peripheral Nervous System (PNS):
neurons & their process present in all the body.
Somatic Nervous system
Autonomic nervous system
which controls most visceral functions
ARTERIAL PRESSURE
GASTROINTESTINAL MOTILITY and SECRETION
URINARY BLADDER EMPTYING
BODY TEMPERATUR and SWEATING

Mind Map

Comparison Between Somatic & Autonomic Nervous System

	SOMATIC INNERVATION	AUTONOMIC INNERVATION
Sensory input	From somatic senses and special senses.	Mainly from interceptors; some from somatic senses and special senses.
Control of motor output	**Voluntary control** from cerebral cortex, with contributions from basal ganglia, cerebellum, brain stem, and spinal cord	**Involuntary control** from hypothalamus, limbic system, brain stem, and spinal cord; limited control from cerebral cortex.
Motor pathways consist of	**Single**, **myelinated somatic** motor neuron that reside in CNS and extends to the skeletal muscle fibers	2 motor neuron: **1st = myelinated preganglionic neuron** (in brain or cord) in which it leaves the CNS to synapse with the 2nd neuron. **2nd = unmyelinated postganglionic neuron** in ganglion outside CNS and its axon extends to the organ it serves
Neurotransmitter	**ONLY ACETYLCHOLINE (ACH)**	Either acetylcholine (Ach) Or noradrenaline (NE)
Effectors	Skeletal muscle.	Smooth muscle, cardiac muscle, and glands
Responses	Contraction of skeletal muscle.	Contraction or relaxation of smooth muscle; increased or decreased rate and force of contraction of cardiac muscle; increased or decreased secretions of glands.

Sympathetic & Parasympathetic Nervous System

	SYMPATHETIC	PARASYMPATHETIC
Origin	**Thoracolumbar lateral horns of the spinal+segments T1-L2.**	**craniosacral outflow:** * cranial nerves **III, VII, IX and X** in the brain stem * Sacral segment of the spinal cord **(S2,S3,S4)**
preganglionic neurons	• **Short, lightly myelinated**	• **Long, lightly myelinated** • **Cholinergic** "release Ach" There are few cranial parasympathetic nerves, in which the preganglionic fibers pass uninterrupted all the way to the organ that is to be controlled.
Nneurotransmitter in the ganglion	**Cholinergic** "release Ach"	
Ganglia	close to spinal cord	close to or on target organs
Postganglionic neuron	• **Long, unmyelinated**	• **Short, unmyelinated**
NEUROTRANMETER IN EFFECTOR ORGAN	• **Adrenergic** "release NE" • **Except sweat glands that are Cholinergic** "release Ach" Therefore, noradrenaline is called a sympathetic transmitter.	• **Cholinergic** "release Ach" Therefore, acetylcholine is called a parasympathetic transmitter.

SYMPATHETIC & PARASYMPATHETIC POSTGANGLIONIC NEURONS

Parasympathetic postganglionic neurons either all or almost all of are cholinergic

The terminal nerve endings of the parasympathetic system all or virtually all secrete acetylcholine

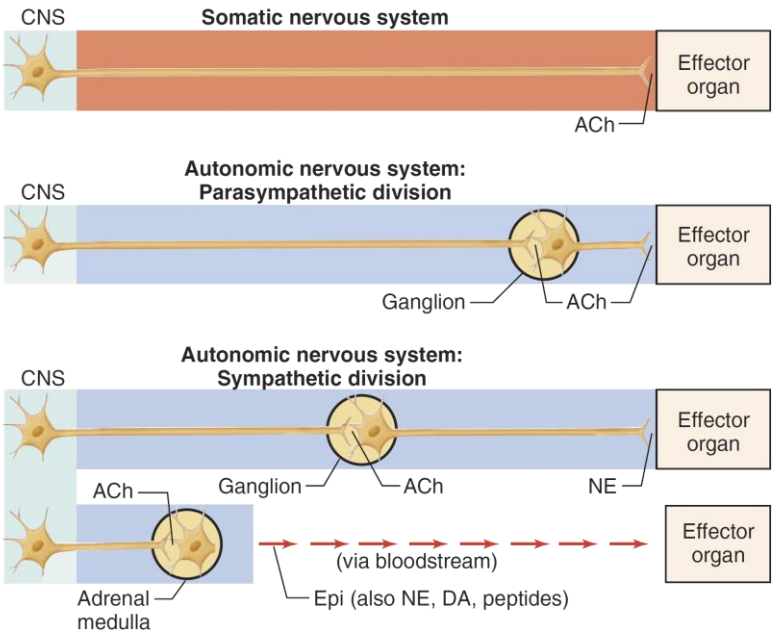
Therefore, acetylcholine is called a parasympathetic transmitter

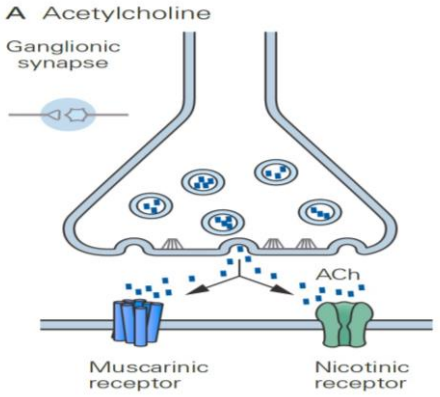
Therefore, noradrenaline is called a sympathetic transmitter

Sympathetic postganglionic neurons are adrenergic.

However, the postganglionic sympathetic nerve fibers to the sweat glands and perhaps to a very few blood vessels are cholinergic.

Almost all of the sympathetic nerve endings secrete noradrenaline, but a few secrete acetylcholine.





In sympathetic ganglia ach can activate

Nicotinic receptors to produce fast postsynaptic potentials

Muscarinic receptors to produce slow postsynaptic potentials

SECRETION OF NORADRENALINE BY POSTGANGLIONIC NERVE ENDINGS – VARISCOSITIES

- Many of the parasympathetic nerve fibers and almost all the sympathetic fibers merely touch the effector cells of the organs that they innervate

Where these filaments interact with cells to be stimulated, they usually have bulbous enlargements called varicosities

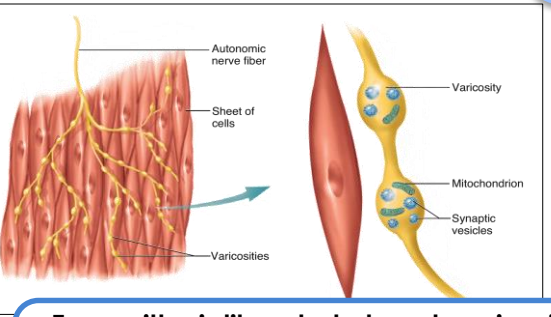
Varicosities release neurotransmitter according to the same mechanism as a synapse

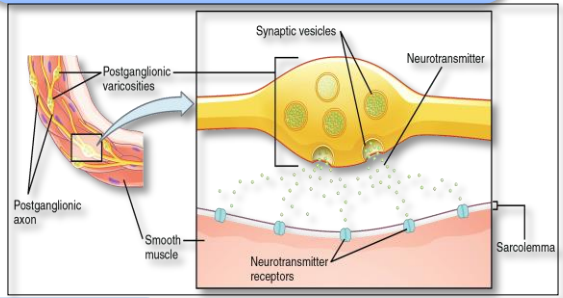
- In these varicosities the transmitter vesicles of acetylcholine or noradrenaline are synthesized and stored

- The multiple branches of the noradrenergic and, cholinergic neurons are beaded with enlargements (varicosities) and contain synaptic vesicles

In noradrenergic neurons, the varicosities are about 5 µm apart, with up to 20,000 varicosities per neuron

Some of these nerve fibres contain clear vesicles and are cholinergic, whereas others contain the characteristic dense-core vesicles that contain noradrenaline





Transmitter is liberated at each varicosity, that is, at many locations along each axon. This arrangement permits one Neuron to innervate many effector cells.

CHOLINERGIC NEURONS IN THE AUTONOMIC NERVOUS SYSTEM

- **All preganglionic neurons are cholinergic both in SNS and PSNS**
- All parasympathetic postganglionic neurons **are cholinergic**
- Sympathetic postganglionic neurons that end on blood vessels **are cholinergic**
- Sympathetic postganglionic neurons that innervate sweat glands **are cholinergic.**

EXCITATORY AND INHIBITORY ACTIONS OF SYMPATHETIC AND PARASYMPATHETIC STIMULATION

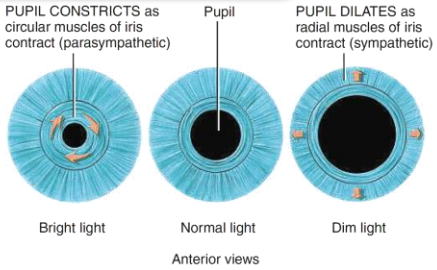
NOTE THAT THE TWO SYSTEMS OCCASIONALLY ACT RECIPROCALLY TO EACH OTHER.

RESPONSES DUE TO STIMULATION OF THE SYMPATHETIC / PARASYMPATHETIC

ON THE EYE

Parasympathetic stimulation contracts the circular muscle of the iris to constrict the pupil

Sympathetic stimulation contracts the radial fibers of the iris that dilate the pupil



The sympathetics become stimulated during periods of excitement and increase pupillary opening at these times

ON THE GLANDS

Many gastrointestinal glands

Glands strongly stimulated by the parasympathetic nervous system, usually resulting in copious quantities of watery secretion

- Nasal
- Lacrimal
- Salivary

ARTERIAL PRESSURE

SYMPATHETIC STIMULATION

- Increases both propulsion by the heart and resistance to flow
- This usually causes a marked *acute* increase in arterial pressure

MODERATE PARASYMPATHETIC STIMULATION

- Via the vagal nerves decreases pumping by the heart
- Has virtually no effect on vascular peripheral resistance.
- Therefore, the usual effect is a slight decrease in arterial pressure.

The arterial pressure is determined by two factors:

- Propulsion of blood by the heart
- Resistance to flow of blood through the peripheral blood vessels.

RESPONSES DUE TO STIMULATION OF THE SYMPATHETIC / PARASYMPATHETIC

ON THE HEART

SYMPATHETIC STIMULATION

- Increases the overall activity of the heart.
- This effect is accomplished by increasing both the rate and force of heart contraction
- Sympathetic stimulation increases the effectiveness of the heart as a pump, as required during heavy exercise,

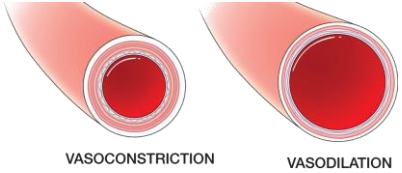
PARASYMPATHETIC STIMULATION

- Causes mainly opposite effects—decreased heart rate and strength of contraction.
- Parasympathetic stimulation decreases heart pumping, allowing the heart to rest between bouts of strenuous activity

Most of the intodermal ducts are inhibited by sympathetic stimulation but excited by parasympathetic stimulation IN THE LIVER, IN THE GALLBLADDER, URETER and the URINARY BLADDER

SYSTEMIC BLOOD VESSELS

MOST SYSTEMIC BLOOD VESSELS, ESPECIALLY THOSE OF THE ABDOMINAL VISCERA AND SKIN OF THE LIMBS, ARE CONSTRICTED BY SYMPATHETIC STIMULATION.



PARASYMPATHETIC STIMULATION HAS ALMOST NO EFFECTS ON MOST BLOOD VESSELS

THE GASTROINTESTINAL SYSTEM

PARASYMPATHETIC STIMULATION,

- In general, increases the overall degree of activity of the gastrointestinal tract
- Promotes peristalsis and relaxes the sphincters,
- Thus allowing rapid propulsion of contents along the tract.

STRONG SYMPATHETIC STIMULATION

- Inhibits peristalsis and increases the tone of the sphincters.
- The net result is greatly slowed propulsion of food through the tract and sometimes decreased secretion

EFFECTS OF SYMPATHETIC AND PARASYMPATHETIC

ORGAN	EFFECT OF SYMPATHETIC STIMULATION	EFFECT OF PARASYMPATHETIC STIMULATION
Eye		
Pupil	Dilated	Constricted
Ciliary muscle	Slight relaxation (far vision)	Constricted (near vision)
Glands Nasal Lacrimal Parotid Submandibular Gastric Pancreatic	Vasoconstriction and slight secretion	Stimulation of copious secretion (containing many enzymes for enzyme-secreting glands)
Sweat glands	Copious sweating (cholinergic)	Sweating on palms of hands
Apocrine glands	Thick, odoriferous secretion	None

ORGAN	EFFECT OF SYMPATHETIC STIMULATION	EFFECT OF PARASYMPATHETIC STIMULATION
Blood vessels	Most often constricted	Most often little or no effect
Heart		
Muscle	Increased rate	Slowed rate
	Increased force of contraction	Decreased force of contraction (especially of atria)
Coronaries	Dilated (β_2); constricted (a)	Dilated
Lungs		
Bronchi	Dilated	Constricted
Blood vessels	Mildly constricted	? Dilated

ORGAN	EFFECT OF SYMPATHETIC STIMULATION	EFFECT OF PARASYMPATHETIC STIMULATION
Systemic arterioles		
Abdominal viscera	Constricted	None
Muscle	Constricted (adrenergic α)	None
	Dilated (adrenergic β_2)	
	Dilated (cholinergic)	
Skin	Constricted	None
Blood		
Coagulation	Increased	None
Glucose	Increased	None
Lipids	Increased	None

ORGAN	EFFECT OF SYMPATHETIC STIMULATION	EFFECT OF PARASYMPATHETIC STIMULATION
Gut		
Lumen	Decreased peristalsis and tone	Increased peristalsis and tone
Sphincter	Increased tone (most times)	Relaxed (most times)
Liver	Glucose released	Slight glycogen synthesis
Gallbladder and bile ducts	Relaxed	Contracted
Kidney	Decreased urine output and increased renin secretion	None
Bladder		
Detrusor	Relaxed (slight)	Contracted
Trigone	Contracted	Relaxed
Penis	Ejaculation	Erection

EFFECTS OF SYMPATHETIC AND PARASYMPATHETIC STIMULATION ON OTHER FUNCTIONS OF THE BODY

Sympathetic stimulation also has multiple metabolic effects such as

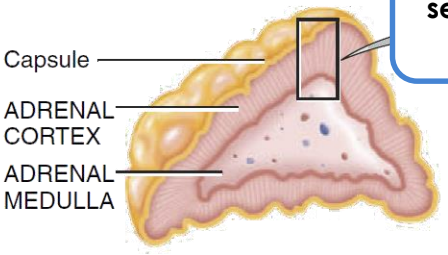
- Release of glucose from the liver
- An increase in blood glucose concentration
- An increase in glycogeno-lysis in both liver and muscle
- An increase in skeletal muscle strength
- An increase in basal metabolic rate
- An increase in mental activity

ORGAN	EFFECT OF SYMPATHETIC STIMULATION	EFFECT OF PARASYMPATHETIC STIMULATION
Basal metabolism	Increased up to 100%	None
Adrenal medullary secretion	Increased	None
Mental activity	Increased	None
Piloerector muscles	Contracted	None
Skeletal muscle	Increased glycogenolysis Increased strength	None
Fat cells	Lipolysis	None

EFFECT OF SYMPATHETIC AND PARASYMPATHETIC STIMULATION ON THE FUNCTION OF THE ADRENAL MEDULLAE

Stimulation of the sympathetic nerves to the adrenal medullae causes large quantities of adrenaline and noradrenaline to be released into the circulating blood

These two hormones are carried in the blood to all tissues of the body.



(b) Section through left adrenal gland

On average, about 80% of the secretion is adrenaline and 20% is noradrenaline

Circulating adrenaline and noradrenaline have almost the same effects on the different organs as the effects caused by direct sympathetic stimulation,

However the effects last 5 to 10 times longer because both of these hormones are removed from the blood slowly over a period of 2 to 4 minutes.

CIRCULATING NORADRENALINE CAUSES

- Constriction of most of the blood vessels of the body
- Increased activity of the heart
- Inhibition of the gastrointestinal tract
- Dilation of the pupils of the eyes

CIRCULATING ADRENALINE

- Adrenaline has 5 to 10 times as great a metabolic effect as noradrenaline.
- Adrenaline causes only weak constriction in comparison with much stronger constriction of the blood vessels in the muscles caused by noradrenaline.
- Has a greater effect on cardiac stimulation than does noradrenaline
- Increases the rates of other metabolic activities, such as glycogenolysis in the liver and muscle and glucose release into the blood.
- Can increase the metabolic rate of the whole body often to as much as 100 percent above normal, in this way increasing the activity and excitability of the body.

1-About 75 percent of all parasympathetic nerve fibers are in the ?

A. Nerve III
B. Nerve X
C. Nerve VII
D. Nerve IX

2-all parasympathetic postganglionic neurons are?

A. Cholinergic
B. Adrenergic
C. Noradrenergic
D. None

3-Postganglionic parasympathetic neurons release the neurotransmitter _____.

A. Acetylcholine
B. Dopamine
C. endorphins
D. norepinephrine

4-Choose the statement that does not accurately reflect the differences between the somatic and autonomic motor systems.

A. Both preganglionic and postganglionic fibers are myelinated.
B. somatic leads to heart muscle; autonomic leads to skeletal muscle
c. somatic impulses are excitatory only; autonomic impulses are excitatory or inhibitory
D. somatic receptors have a specialized motor end plate; autonomic receptors do not

5-Select the response that is not typical of adrenergic stimulation.

A. dilation of the pupil
B. increased salivary secretions
C. dilation of bronchioles
D. closing of gastrointestinal sphincters

6.What type of receptors are involved in the autonomic reflex that inhibits further inhalation in the lungs and, at the same time, increased cardiac rate and stimulates vasodilation?

A. baroreceptors
B. Chemoreceptors
C. type J receptors
D. stretch receptors

1.B
2.A
3.A
4.B
5.B
6.D

MCQs

1-What is the effect of sympathetic stimulation on the kidney?

. Decreased urine output and increased renin secretion

2-what is the effect of parasympathetic stimulation on the muscles?

.No effect

3- circulating noradrenaline causes?

. Inhibition of the gastrointestinal tract

Dilation of the pupils of the eyes

4- circulating adrenaline causes?

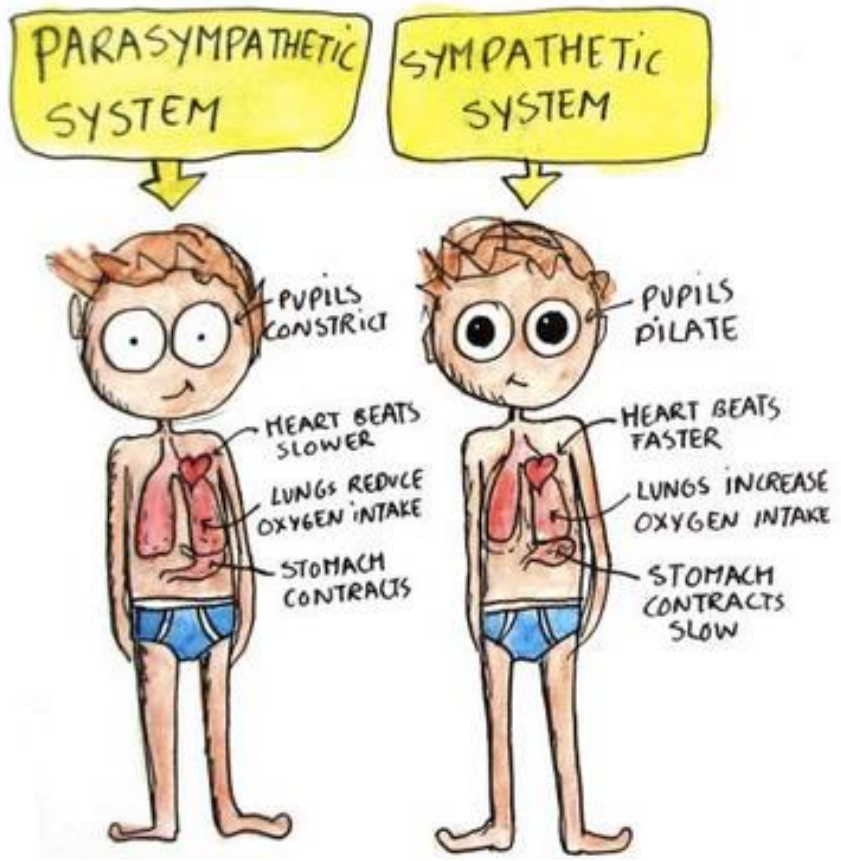
. Can increase the metabolic rate of the whole body

5-. Sympathetic stimulation has multiple metabolic effects such as?

. Release of glucose from the liver

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK



Done By:

- Futoon Salem
- Rana AlJunidel
- Razan Alsubhi