

# **PHARMACOLOGY OF PERIPHERAL NERVOUS SYSTEM**

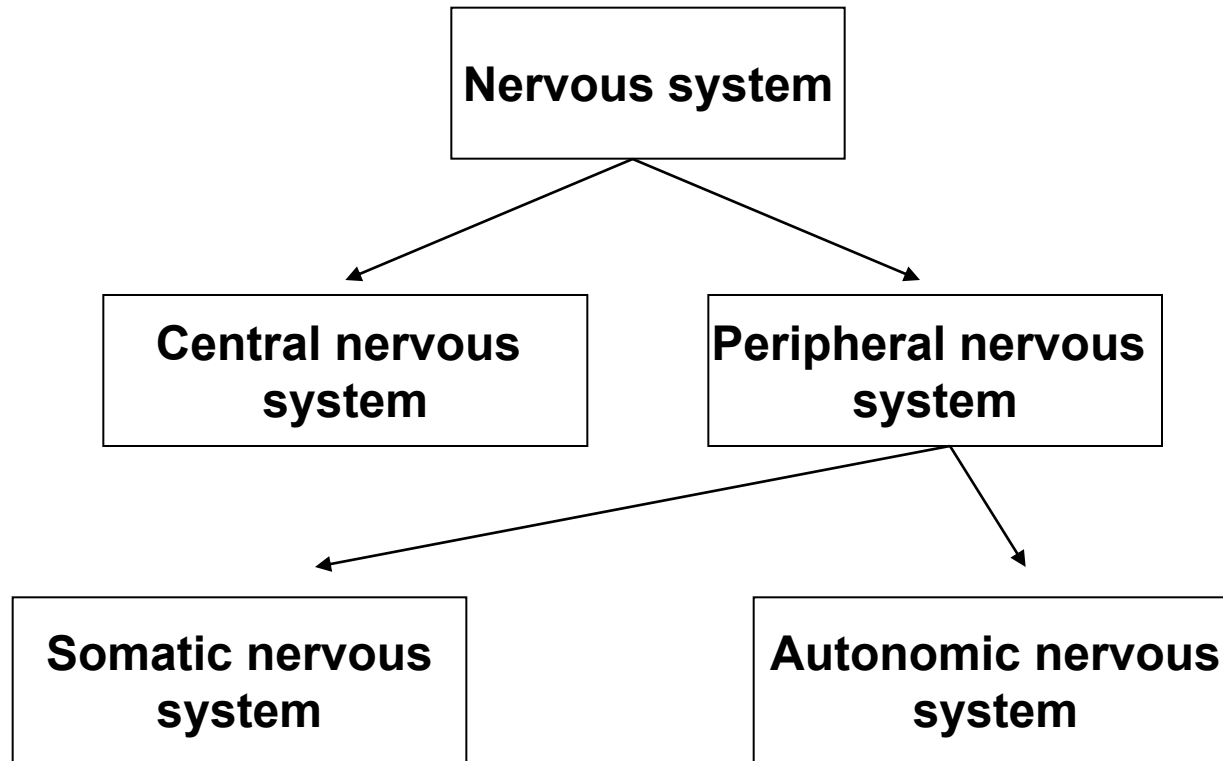
## **AUTONOMIC NERVOUS SYSTEM**

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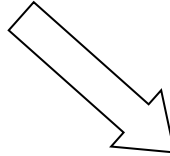
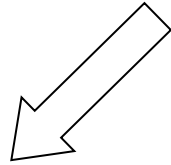
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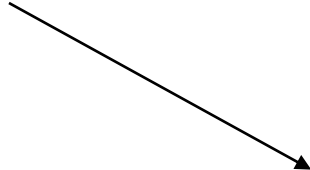
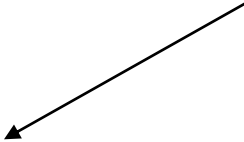


# Autonomic nervous system



**central part**

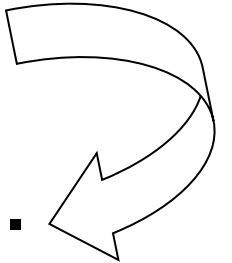
**peripheral part**



**HYPOTHALAMUS  
MEDULLA OBLONG.**

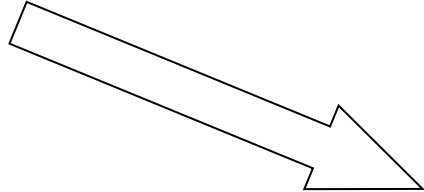
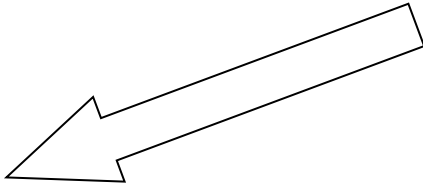
**afferent system**

**efferent system**



- non - myelinated fibers
- pain perception
- visceral perception

**vegetative nerves + ggl.**



**SYMPATHETIC  
NERVOUS SYSTEM**

**PARASYMPATHETIC  
NERVOUS SYSTEM**

# Main functions of ANS

- contractions and relaxations of smooth muscles
- function of all exocrine and some of endocrine glands
- heart functions
- metabolic functions

# ANS

## **Sympathetic**

= adrenergic system

- thoracolumbal s.
- fight or flight
- noradrenaline(NA)
- $\alpha$  a  $\beta$  receptors

## **Parasympathetic**

= cholinergic system

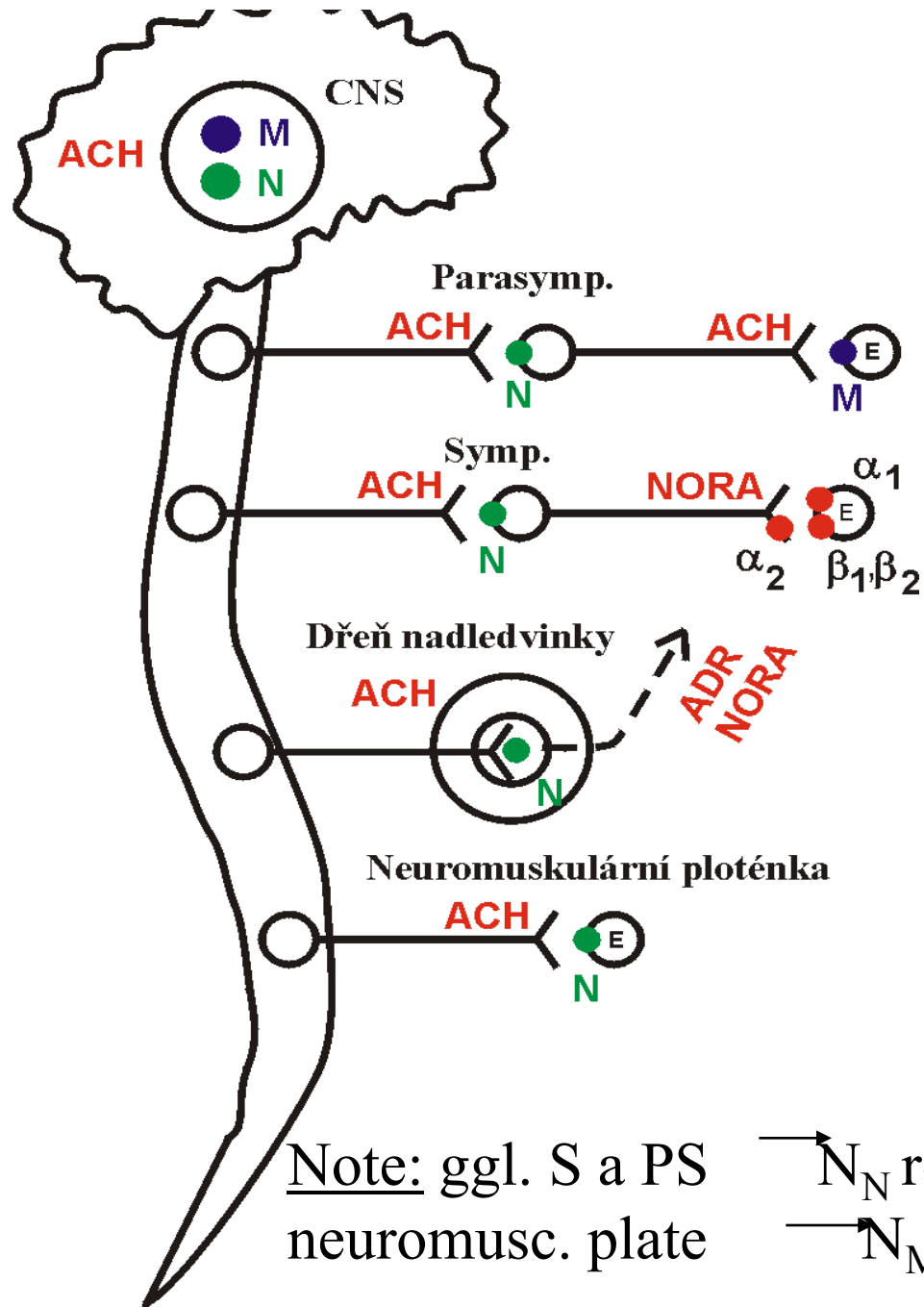
- craniosacral s.
- rest and digest
- acetylcholine
- N a M receptors

# Autonomic nervous system

The activity is mutually regulated

- heterotropic interactions
- homotropic interactions
- most of visceral organs is innervated by both S and PS
- opposite activity - bronchi, heart, bladder,,...
- similar action – salivary glands
- only S – blood vessels

Obr. 1. Autonomic nervous system



Note: ggl. S a PS  
neuromusc. plate

$\rightarrow N_N$  receptors  
 $\rightarrow N_M$  receptors

# Autonomic acting pharmaceuticals

## On the basis of mechanism of action - drugs:

1. **binding to the receptors** for Ach or NA:

a) starting reaction = **agonist - DIRECT MIMETICS**

b) receptor blockade = **antagonist – DIRECT LYTICS**

.....

2. **changing the synaptic concentration of NT –**

intervene in the fate of the Ach or NA (affect the synthesis, storage, release from nerve endings, inactivation); do not bind directly to receptors on the effector organs

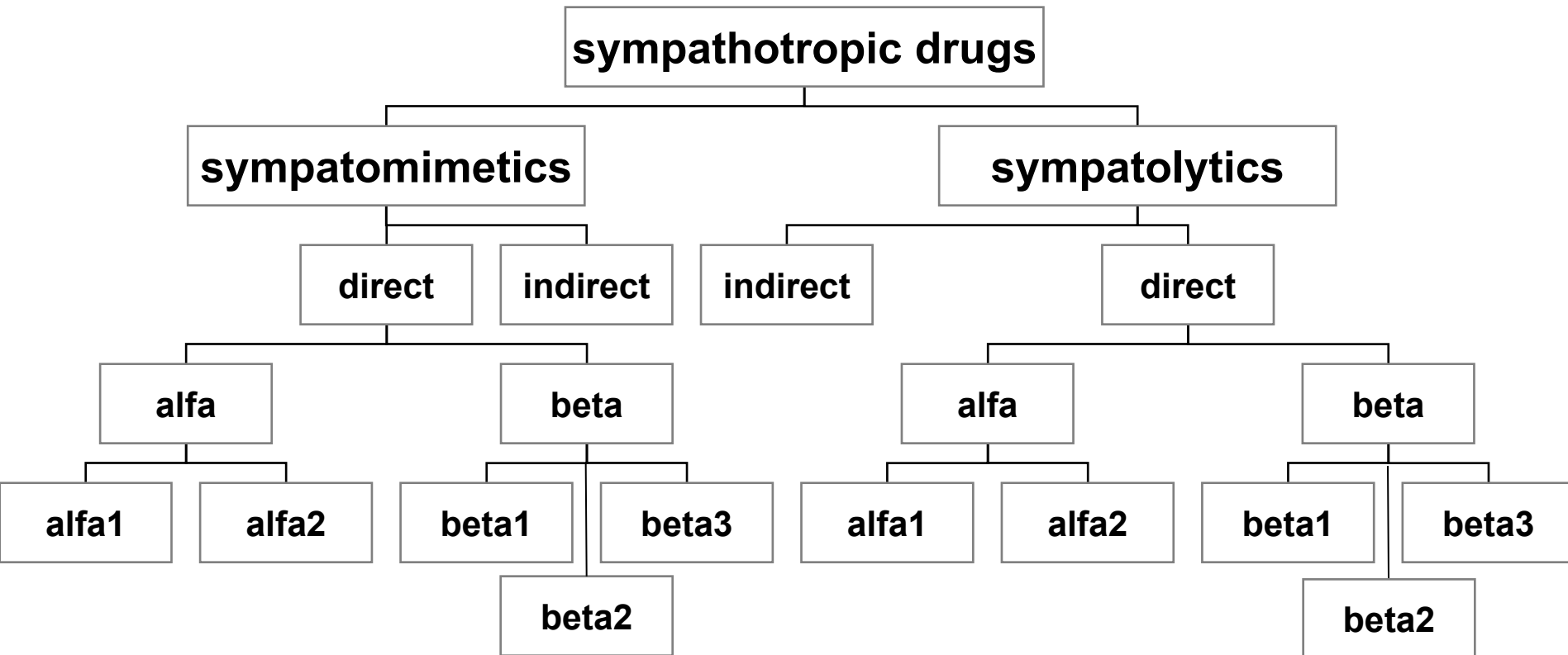
a) increase of NT effect = **INDIRECT MIMETICS**

b) decrease of NT effect = **INDIRECT LYTICS**



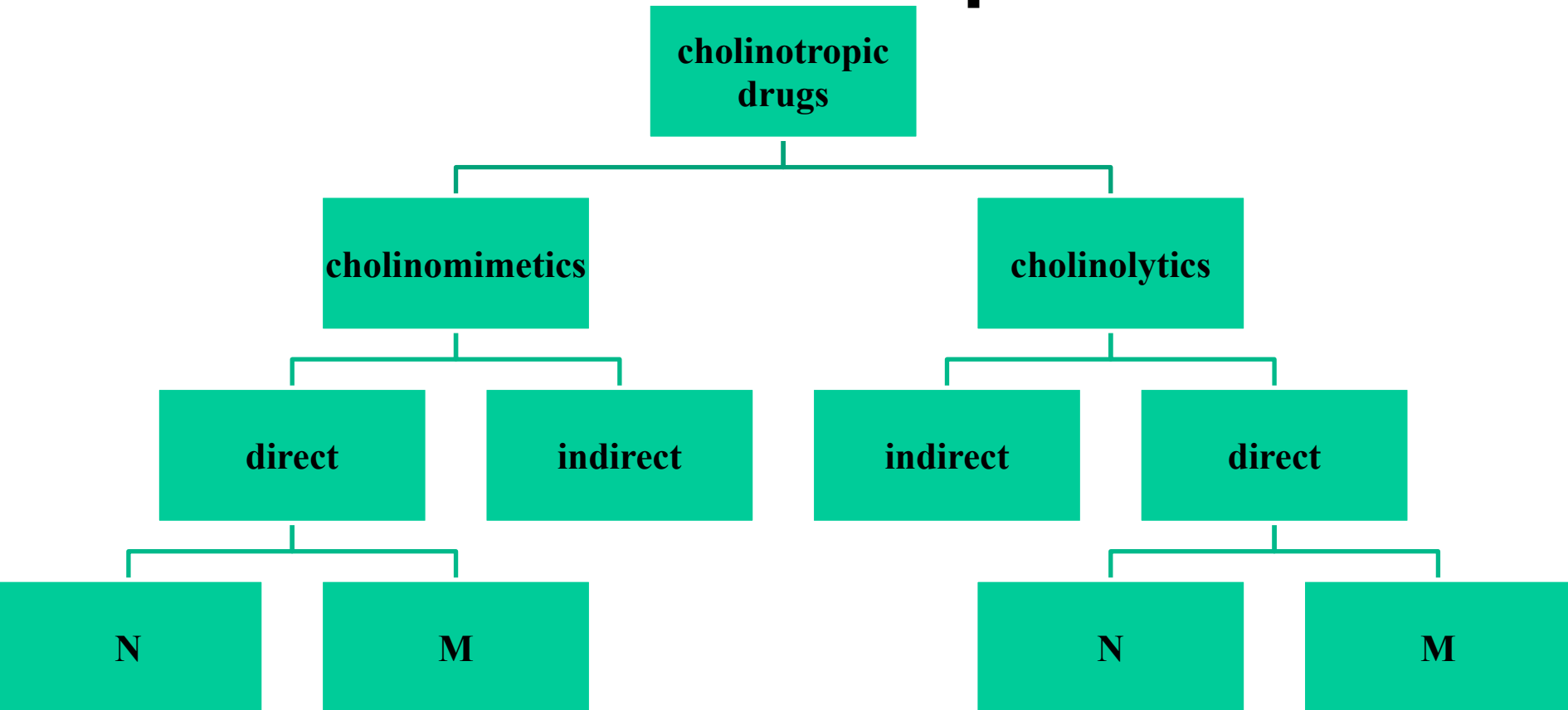
# Vegetative acting drugs

## 2. sympatotropic



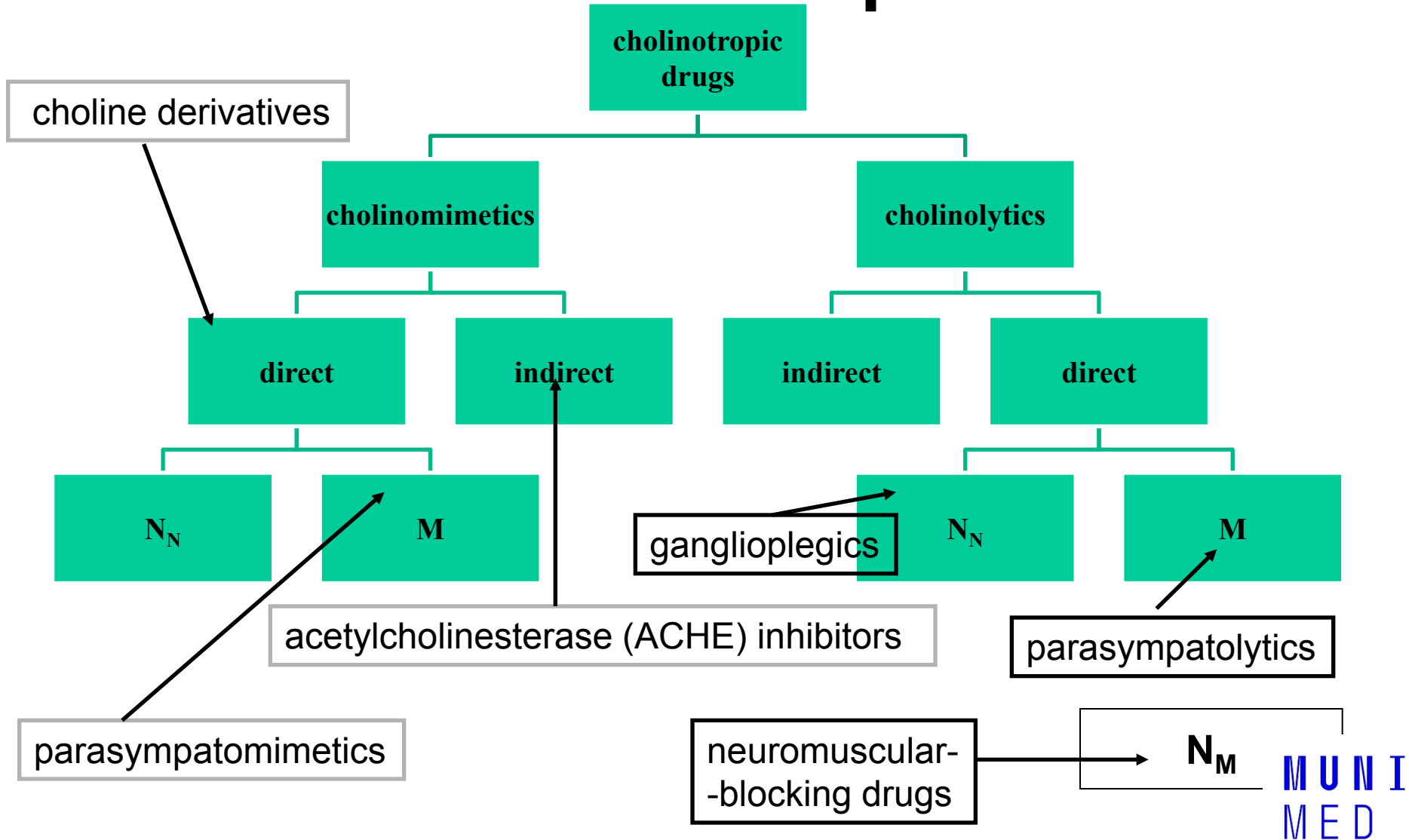
# Vegetative acting drugs

## 2. cholinotropic



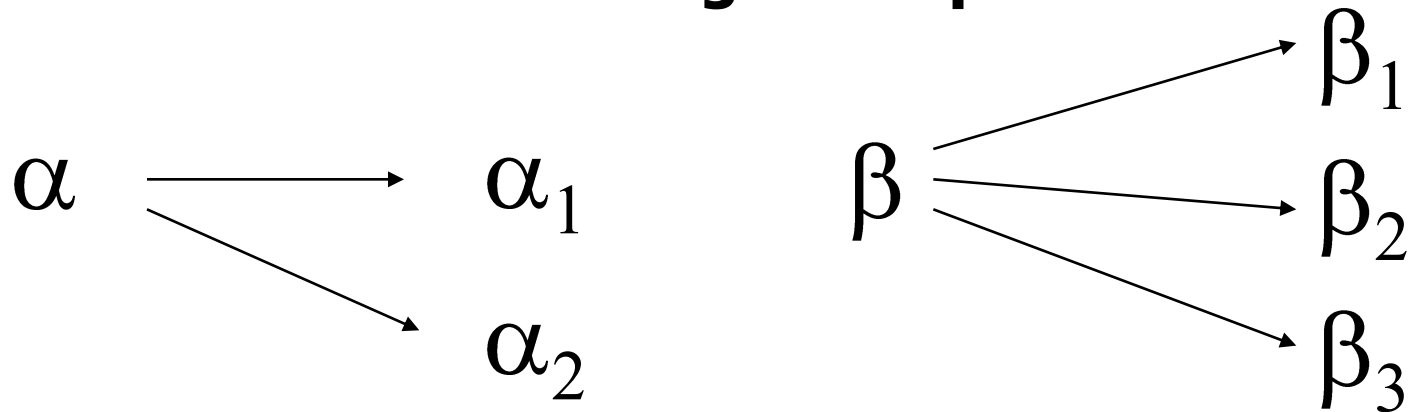
# Vegetative acting drugs

## 2. cholinotropic



# ANS RECEPTORS

## adrenergic receptors



## cholinergic receptors

**NICOTINE: N**

- skeletal muscle  $N_M$
- vegetative ganglia  $N_N$
- (CNS)

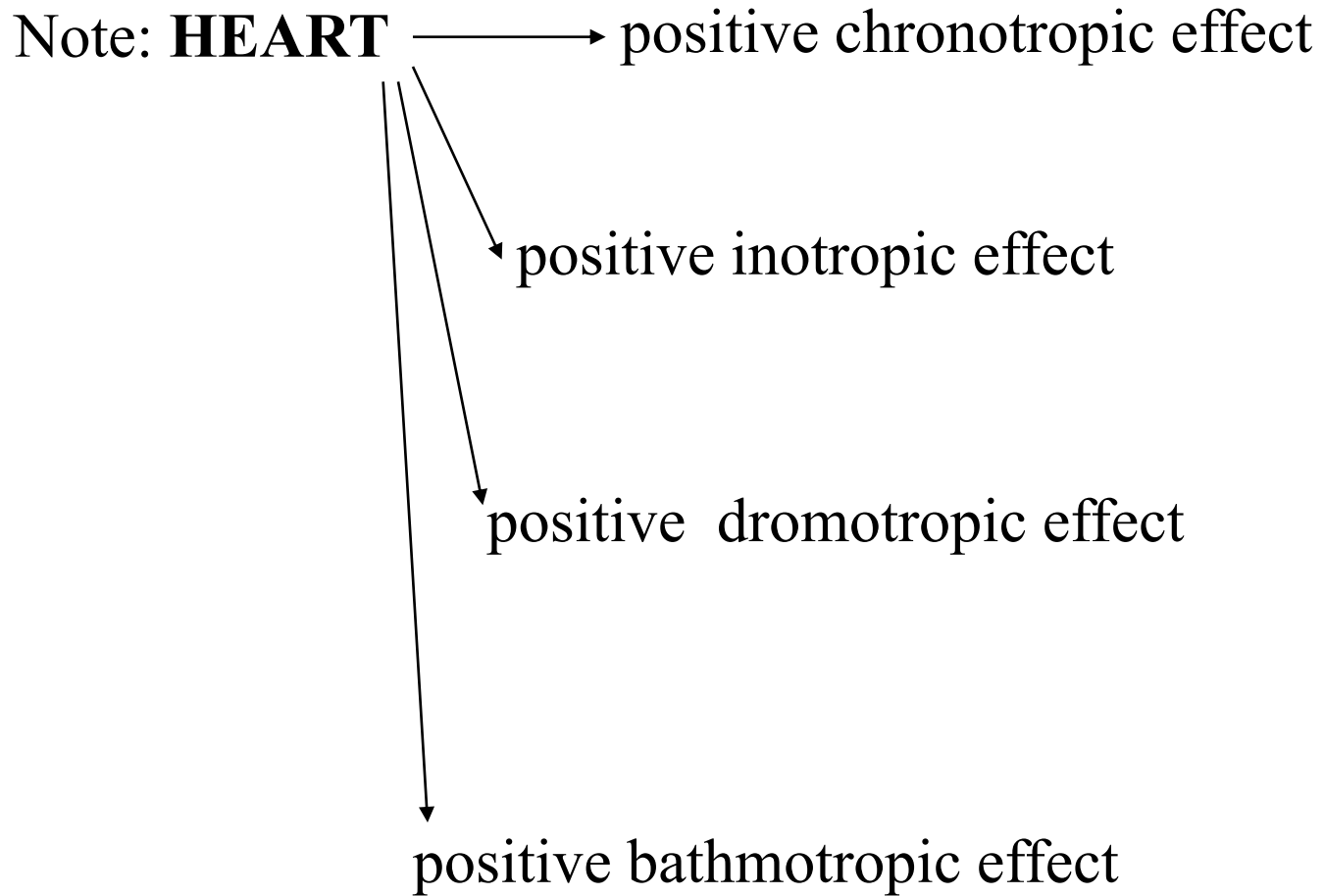
**MUSCARINIC:**

$M_1, M_2, M_3, M_4, M_5$

organ	receptor		sympathetic system	parasympathetic system
heart	$\beta_1$	M	+ chrono, dromo, bathmo, inotropic	- chrono, dromo bathmo, inotrop.
eye	$\alpha_1$ $\beta_2$	M	mydriasis acomodation into the distance	miosis acom.to close
respiratory tract	( $\alpha_1$ ) $\beta_2$	M	bronchoconstriction <u>bronchodilatation</u>	<u>bronchoconstriction</u> $\uparrow$ secretion
blood vessels	$\alpha_1$ ( $\alpha_2$ ) $\beta_2$	M	<u>vasoconstriction</u> vasoconstr. dilatation (coronary, blood vessels in skeletal muscles)	dilatation

organ	receptor		sympathetic system	parasympathetic system
GIT	$\underline{\alpha}_1$	M	↓ motility and tone sphincter contraction secretion inhibition	↑ motility sphincter relaxation secretion stimulation ↑ gastr. secretion
	$\alpha_2$ $\underline{\beta}_2 > \beta_1$	M		
urinary bladder	$\alpha_1$ $\beta_2, \beta_3$	$M_3$	sphinct. contraction relax. of the bladder wall	sphinct. relaxation contract. of the bladder wall
kidney	$\underline{\beta}_1 > \beta_2$		↑ renin secretion	
uterus	$\alpha_1$ $\beta_2$		contraction relaxation-tocolysis	

organ	receptor	sympathetic system	parasympathetic system
liver	$\alpha_1, \beta_2$	glycogenolysis gluconeogenesis	
pancreas	$\alpha_2$ $\beta_2$	↓insulin secretion ↑insulin secretion	
sexual organs	$\alpha_1$ M	ejaculation	erection
glands	$\alpha_1$ M $\beta_2$	sparse secretion viscous secretion	sparse significantly increased secretion





# Adrenergic receptors

- metabotropic
- $\alpha_1$ ,  $\alpha_2$  a  $\beta_1$ ,  $\beta_2$  a  $\beta_3$
- stimulated by noradrenaline (norepinephrine)

# Receptor $\alpha_1$ stimulation:

- vasoconstriction (skin, mucous membranes, splanchnic area,..)
- mydriasis  
(+  $\downarrow$  intraocular pressure)
- contraction of pregnant uterus
- ejaculation
- urinary bladder sphincter contraction, GIT sphincter contraction
- glycogenolysis and gluconeogenesis stimulation
- (reduce secretion of bronchial glands)

# Receptor $\alpha_2$ stimulation:

- (presynaptic) increased NA release (espec. in CNS)
- stimulation of platelet aggregation
- vasoconstriction in local application, otherwise the influence of stimulation of central receptors to reduce sympathetic tone and BP
- hypotensive effect of central mechanism
- inhibition GIT secretion
- inhibition of lipolysis, increased fat storage

# Receptor $\beta_1$ stimulation :

## heart:

- $\uparrow$  HR (+ **chronotropic** effect) SA node
- $\uparrow$  automaticity (+ **bathmotropic**) AV node, ventricles
- $\uparrow$  force of heart contraction (**inotropic effect**)
- $\uparrow$  conduction (**dromotropic effect**)
- $\uparrow$  oxygen consumption

## kidney:

- $\uparrow$  renin secretion

# Receptor $\beta_2$ stimulation:

- vasodilatation, espec. in skeletal muscles ("preparation for fight or flight"),  $\downarrow$  diastol. BP, vasodilatation in coronar blood vessels
- bronchodilatation
- relaxation of uterus (indic. in impending preterm birth)
- intestine wall relaxation
- intestinal passage decrease
- urinary bladder wall relaxation
- glycogenolysis -  $\uparrow$  glycemia, increased insulin secretion
- blockade of mast cells degranulation

# Receptor $\beta_3$ stimulation:

- *lipolysis*
- *urinary bladder wall relaxation (m. detrusor)*

# Cholinergic receptors

## MUSCARINIC:

M<sub>1</sub> („neural“) – CNS, peripheral neurons, parietal cells of stomach, (glands with external secretion)

M<sub>2</sub> („heart“) - heart (SA, atria, AV, ventricles), (smooth muscle (GIT), neuronal tissue), presynapt. neur. endings

M<sub>3</sub> – glands, blood vessels (smooth muscle, hl. sval, endothelium), smooth muscles: bronchial muscles, GIT, urinary bladder, eye

M<sub>4</sub> – salivary glands, GIT (muscles), eye, CNS

M<sub>5</sub> – lungs, CNS

# Cholinergic receptors

- M – metabotropic
- stimulated by acetylcholine
- N – coupled with ion channels
- stimulated by nicotine