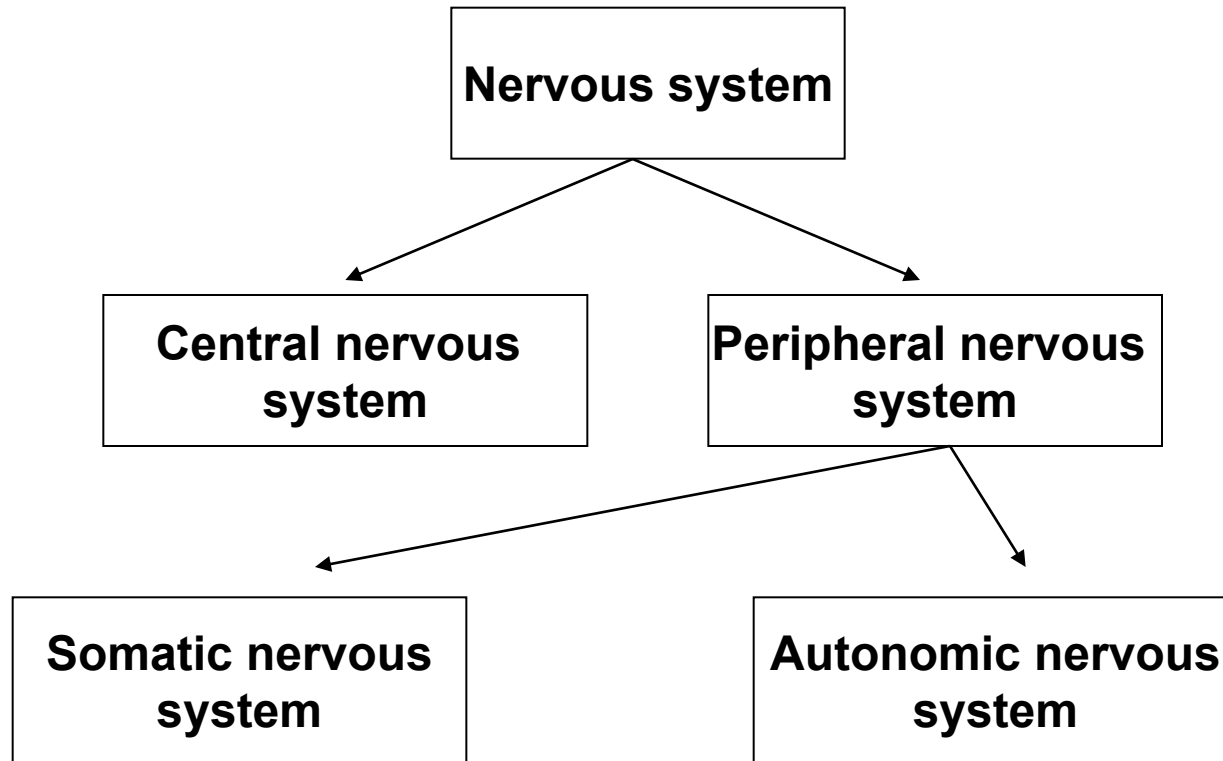
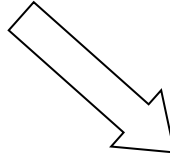
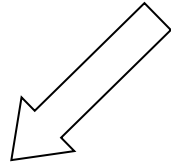


PHARMACOLOGY OF PERIPHERAL NERVOUS SYSTEM

AUTONOMIC NERVOUS SYSTEM

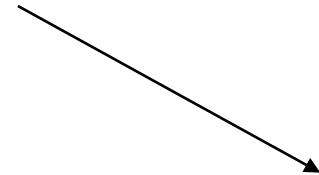
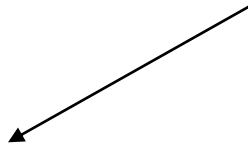


Autonomic nervous system



central part

peripheral part



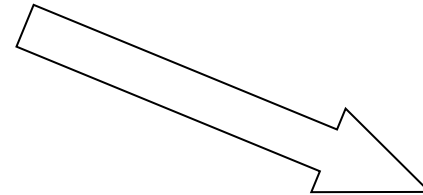
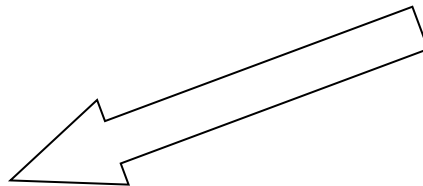
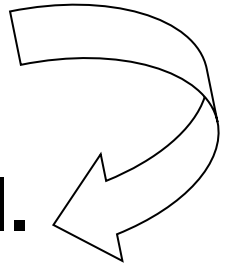
**HYPOTHALAMUS
MEDULLA OBLONG.**

afferent system

efferent system

- non - myelinated fibers
- pain perception
- visceral perception

vegetative nerves + ggl.



**SYMPATHETIC
NERVOUS SYSTEM**

**PARASYMPATHETIC
NERVOUS SYSTEM**

Peripheral nervous system:

⇒ **autonomic nervous system
(ANS)**

⇒ **enteric NS**

⇒ **somatic efferent (motoric) system**

⇒ **senzoric (afferent) fibers**

ANS – mediated the transfer of the impulses between the central nervous system (CNS) and the effector tissues; independent of the control of the will (smooth muscle, myocardium, exocrine glands, etc.), adapts the response of the organism to changes of the external and internal environment

Somatic efferent (motoric) system - converts impulses from the CNS to the will of controlled skeletal muscles

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)
- α a β receptors

Parasympathetic

= cholinergic system

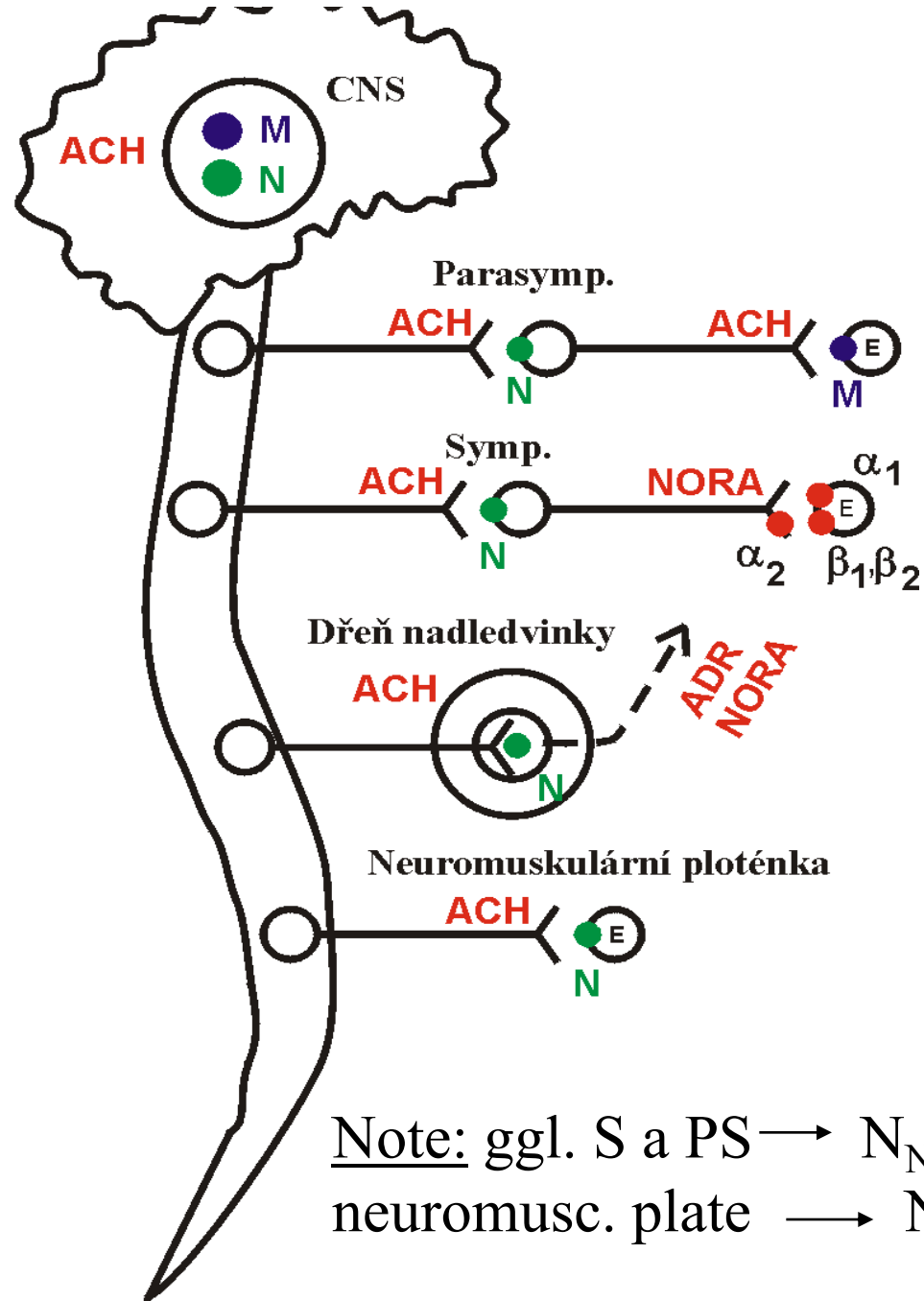
- craniosacral s.
- rest and digest
- acetylcholine
- N a M receptors

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 \rightarrow N_N receptors
neuromusc. plate \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 –**

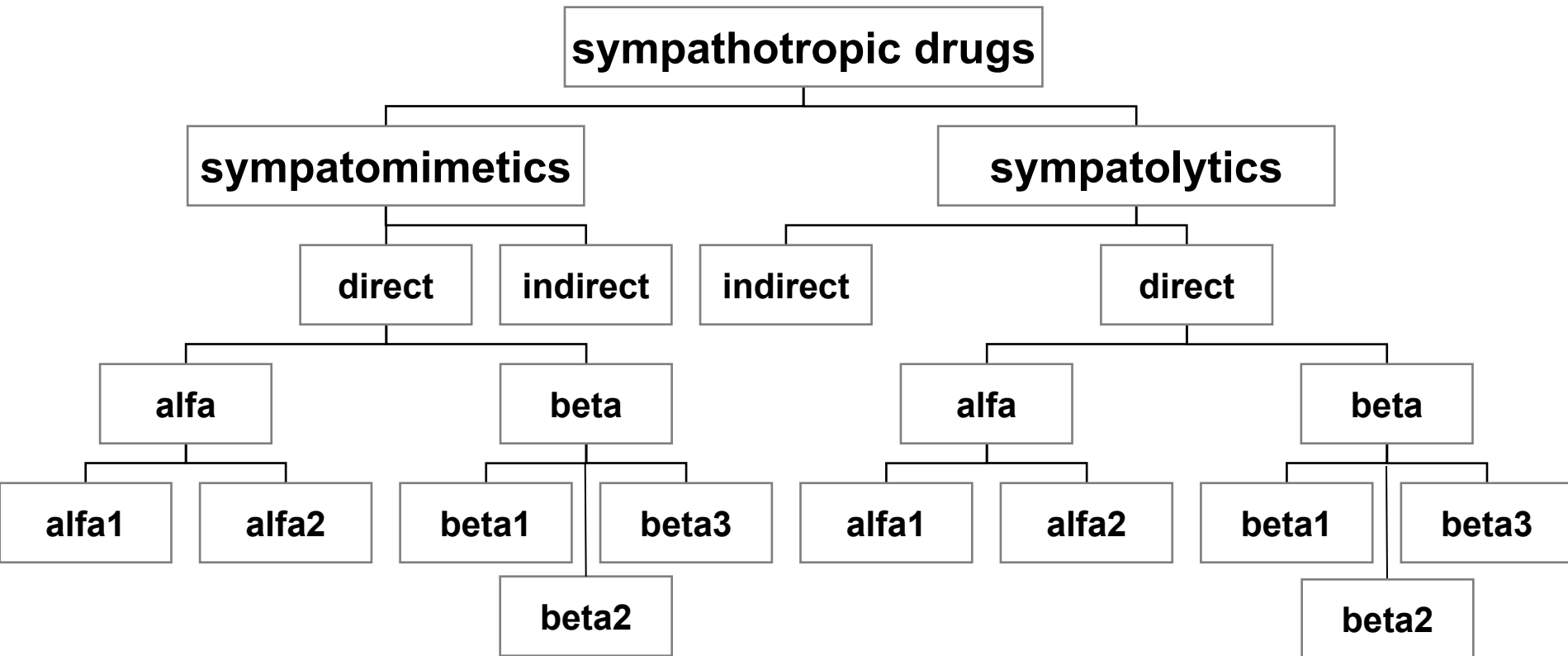
intervene in the fate of the Ach or NA (affect the synthesis, storage, release from nerve endings, inactivation); do not bind directly to receptors on the effector organs

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

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

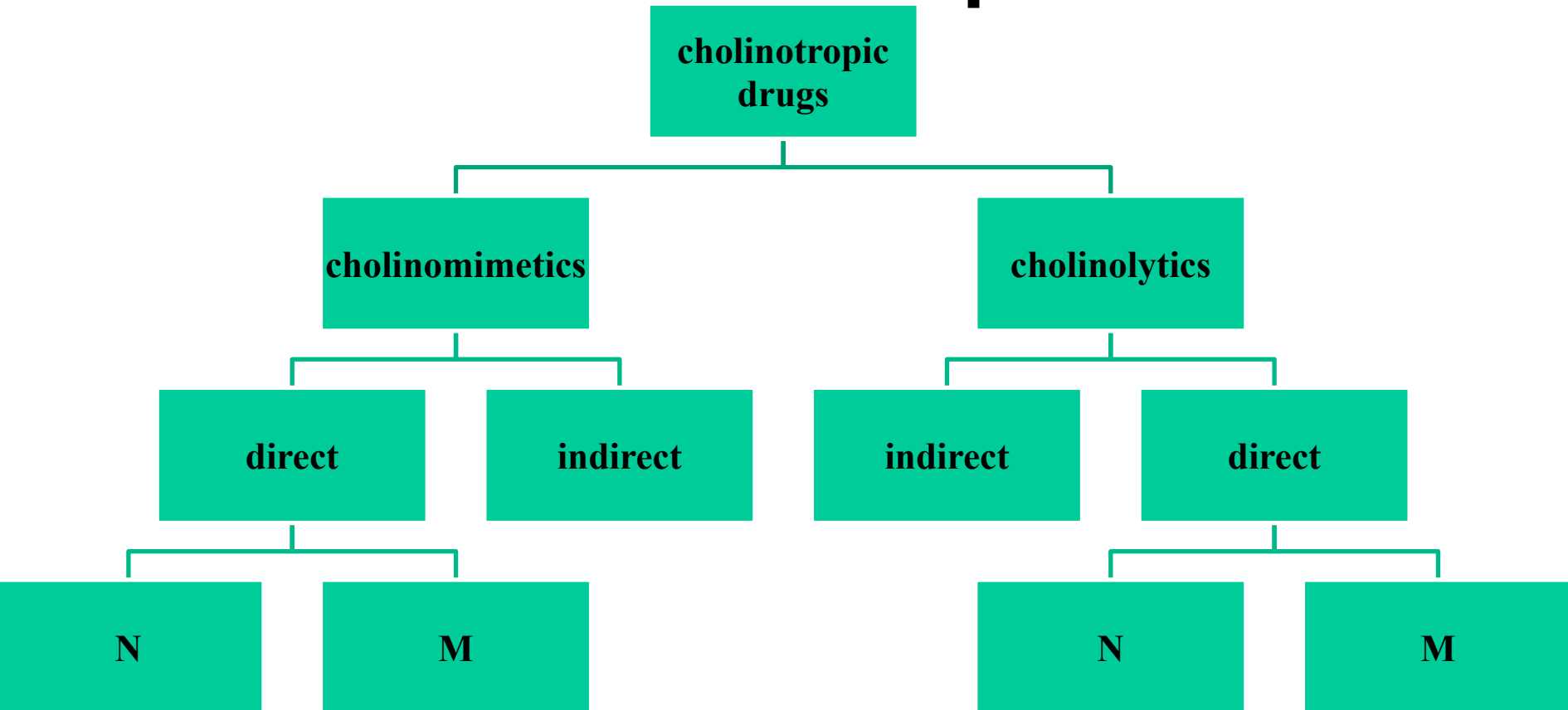
Vegetative acting drugs

2. sympatotropic



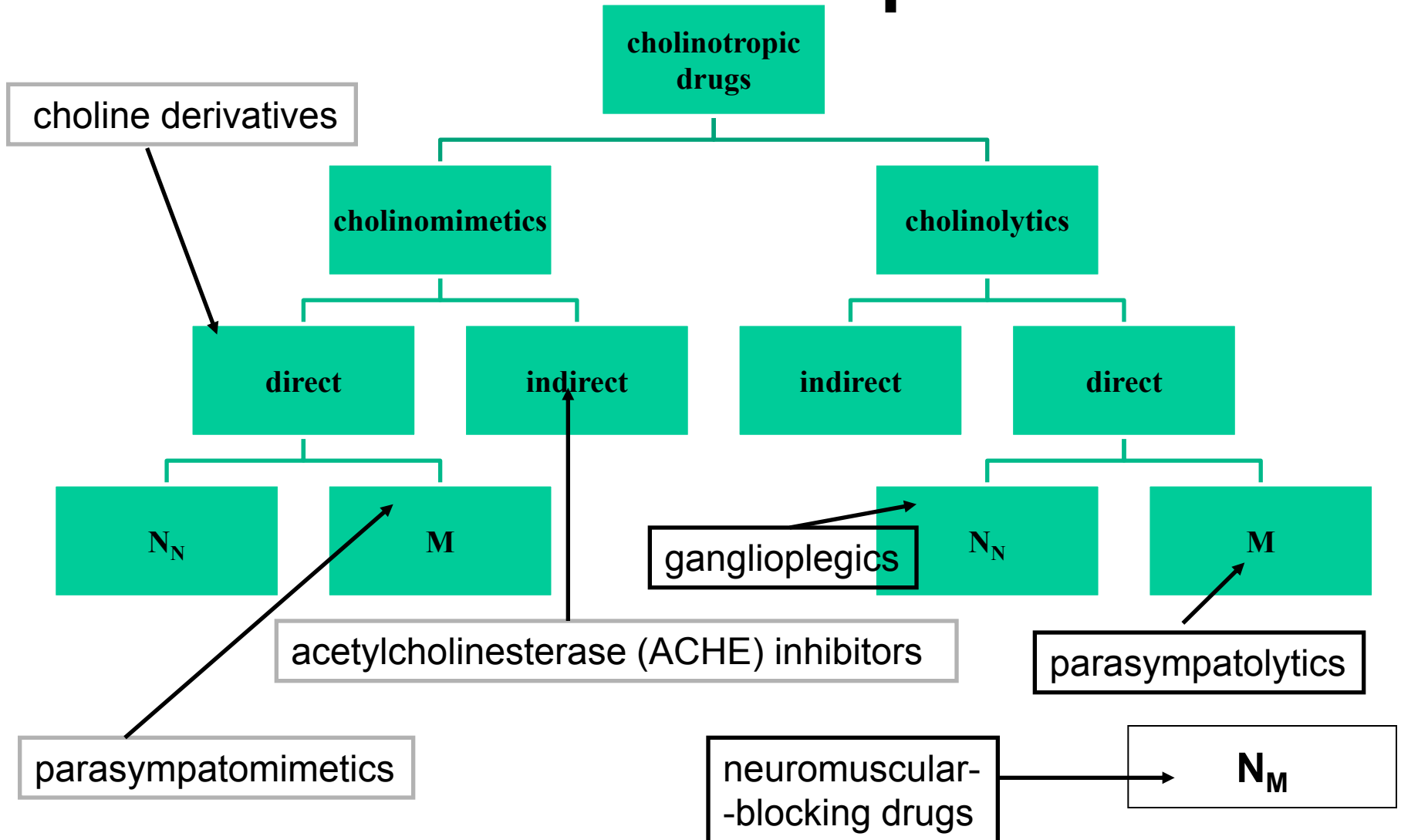
Vegetative acting drugs

2. cholinotropic



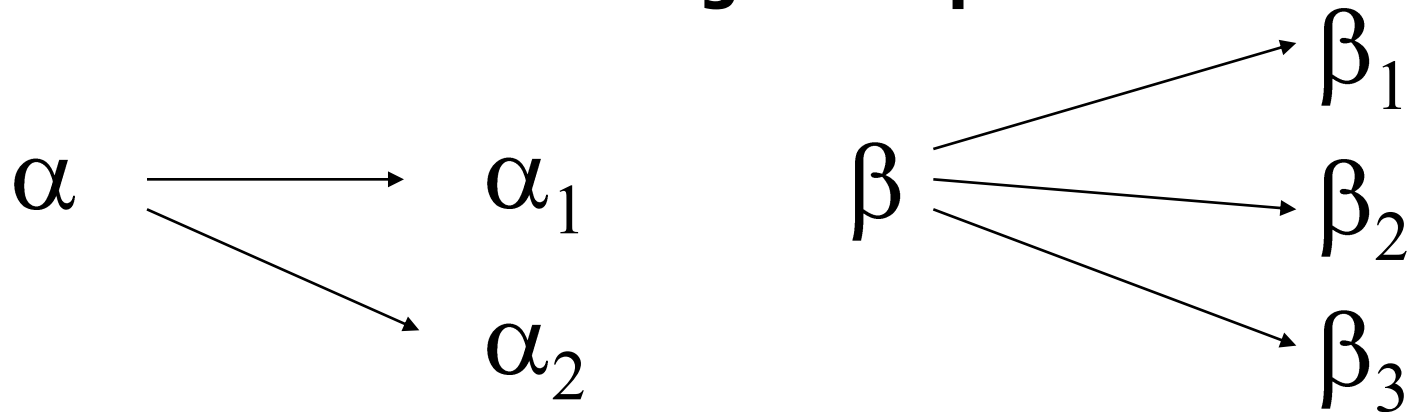
Vegetative acting drugs

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	β_1	M	+ chrono, dromo, bathmo, inotropic	- chrono, dromo bathmo, inotrop.
eye	α_1 β_2	M	mydriasis acomodation into the distance	miosis acom.to close
respiratory tract	(α_1) β_2	M	bronchoconstriction <u>bronchodilatation</u>	<u>bronchoconstriction</u> \uparrow secretion
blood vessels	α_1 (α_2) β_2	M	<u>vasoconstriction</u> vasoconstr. dilatation (coronary, blood vessels in skeletal muscles)	dilatation

organ	receptor		sympathetic system	parasympathetic system
GIT	$\underline{\alpha}_1$ α_2 $\underline{\beta}_2 > \beta_1$	M M	↓ motility and tone sphincter contraction secretion inhibition	↑ motility sphincter relaxation secretion stimulation ↑ gastr. secretion
urinary bladder	α_1 β_2, β_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	α_1 β_2		contraction relaxation-tocolysis	

organ	receptor	sympathetic system	parasympathetic system
liver	α_1, β_2	glycogenolysis gluconeogenesis	
pancreas	α_2 β_2	↓insulin secretion ↑insulin secretion	
sexual organs	α_1 M	ejaculation	erection
glands	α_1 M β_2	sparse secretion viscous secretion	sparse significantly increased secretion

Note: **HEART** → positive chronotropic effect

→ positive inotropic effect

→ positive dromotropic effect

→ positive bathmotropic effect

Adrenergic receptors

- metabotropic
- α_1 , α_2 a β_1 , β_2 a β_3
- stimulated by noradrenaline (norepinephrine)

Receptor α_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 α_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 β_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 β_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 β_3 stimulation:

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

Cholinergic receptors

MUSCARINIC:

M₁ („neural“) – CNS, peripheral neurons, parietal cells of stomach, (glands with external secretion)

M₂ („heart“) - heart (SA, atria, AV, ventricles), (smooth muscle (GIT), neuronal tissue), presynapt. neur. endings

M₃ – glands, blood vessels (smooth muscle, hl. sval, endothelium), smooth muscles: bronchial muscles, GIT, urinary bladder, eye

M₄ – salivary glands, GIT (muscles), eye, CNS

M₅ – lungs, CNS

Cholinergic receptors

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