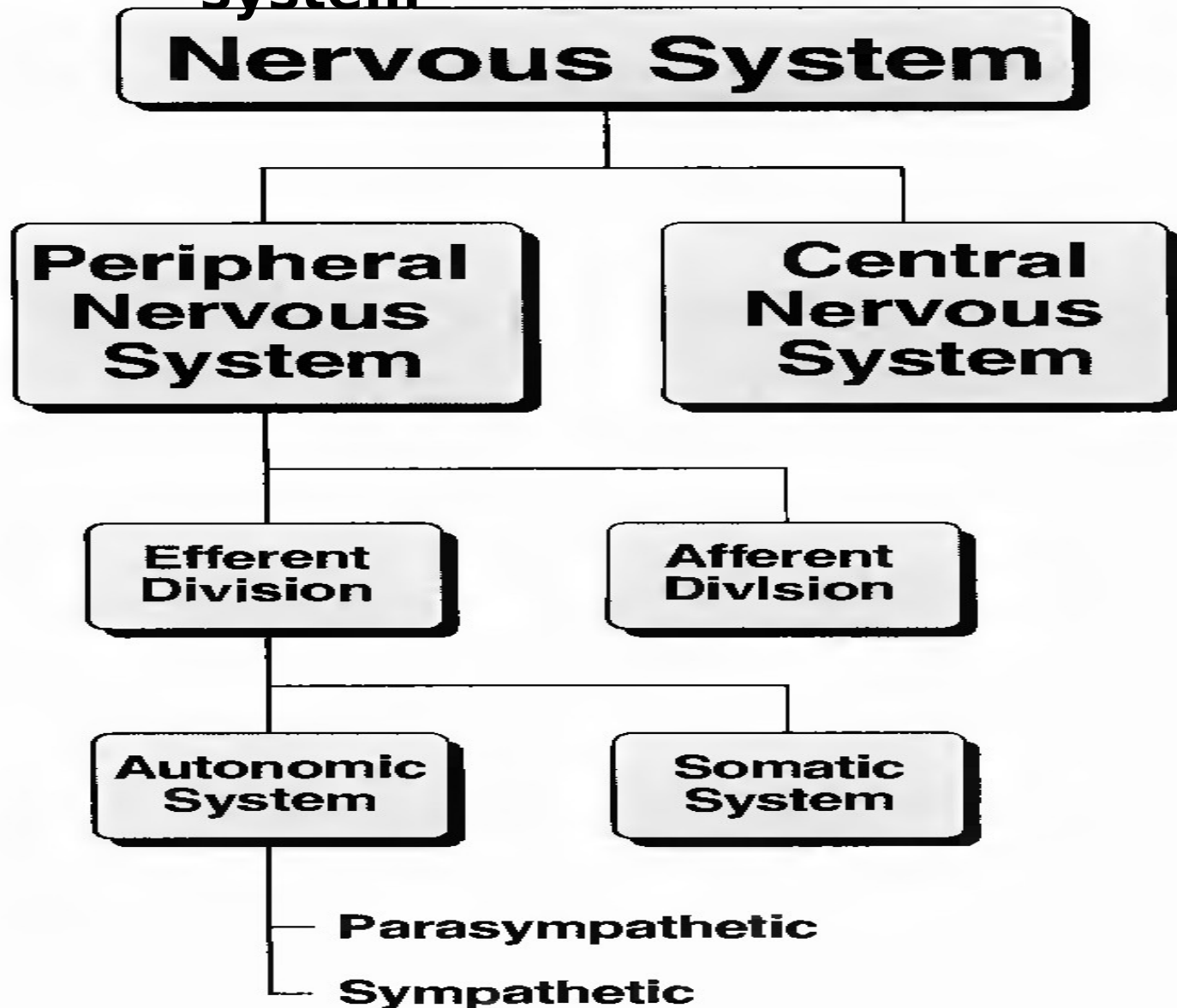


Drugs acting on autonomic nervous system

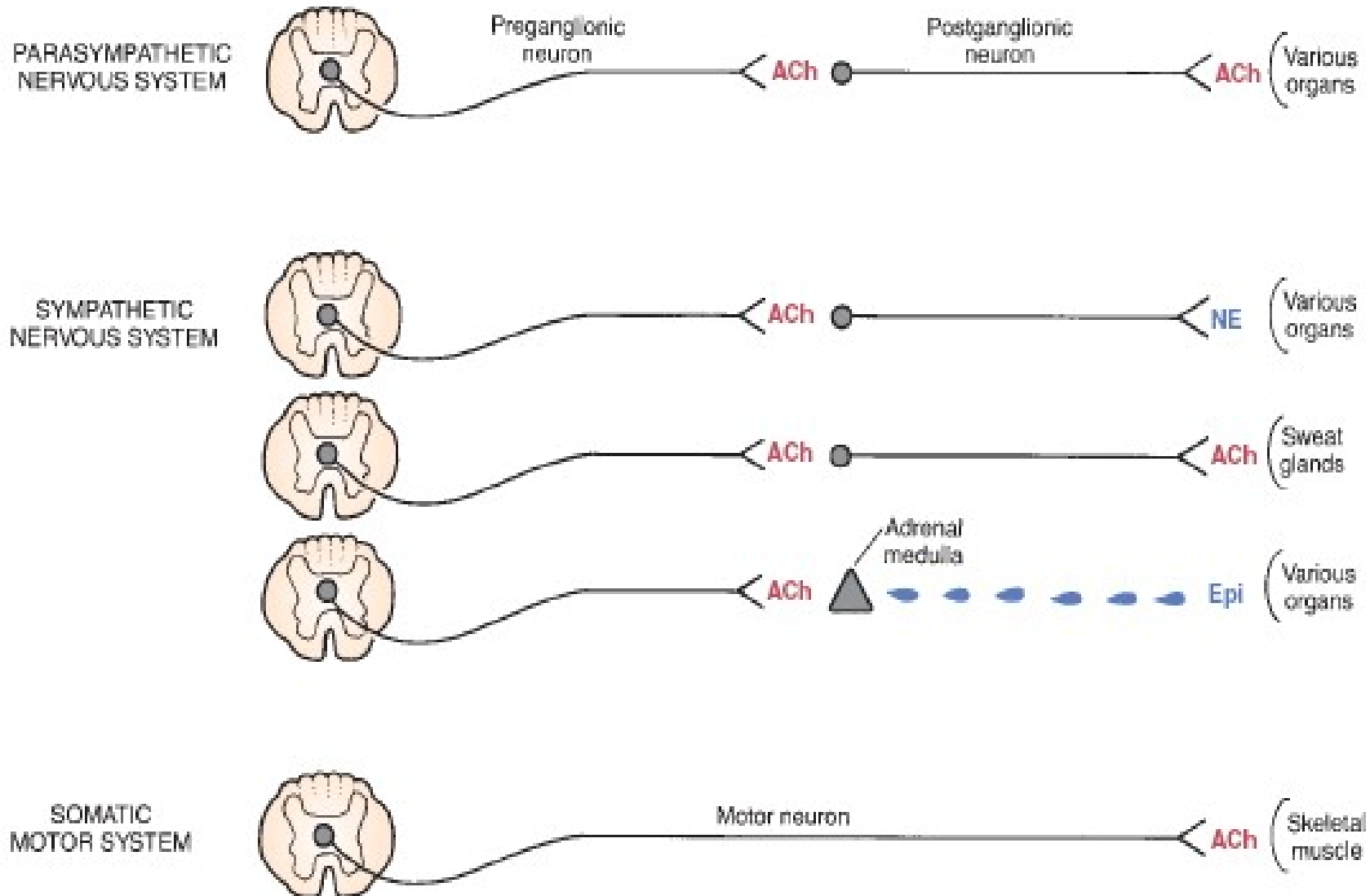
Introduction

- The autonomic nervous system consists of two large divisions:
 - **sympathetic** (thoracolumbar) outflow, and
 - **parasympathetic** (craniosacral) outflow.

Division of the nervous system



Employ three different transmitters namely ACh, NA & A.



ACh = acetylcholine, **NE** = norepinephrine, **Epi** = epinephrine

➤ There are two basic categories of receptors associated with the peripheral nervous system.

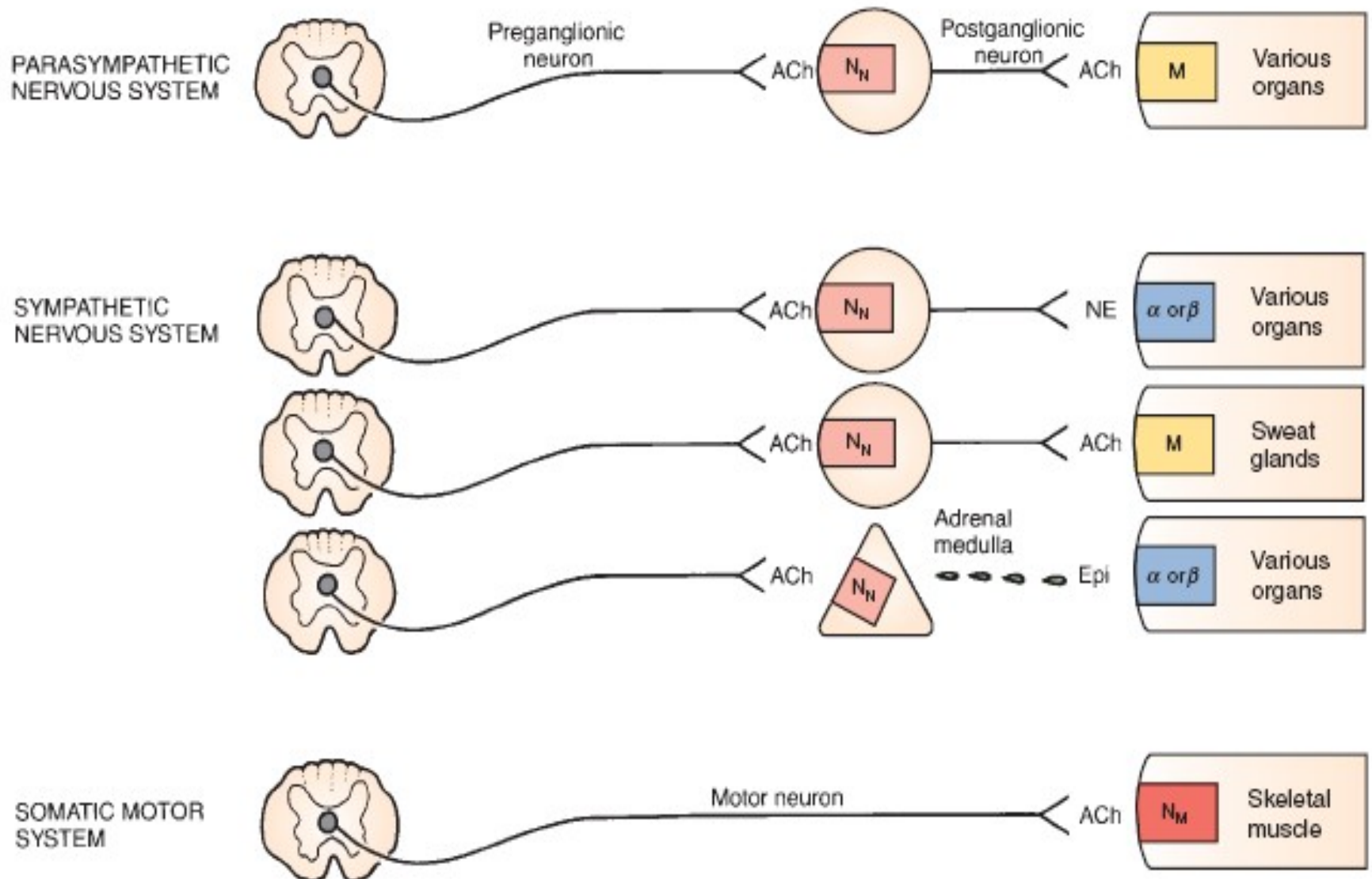
1. cholinergic receptors

2. adrenergic receptors

- **Cholinergic receptors:** are defined as those receptors that mediate responses to acetylcholine.

- **Adrenergic receptors:** are defined as those receptors that mediate responses to noradrenaline and adrenaline.

Locations of cholinergic and adrenergic receptor subtypes



Cholinergic receptor subtypes: N_N = nicotinic_N, N_M = nicotinic_M, and M = muscarinic.
 Adrenergic receptor subtypes: α = alpha and β = beta.

Overview of ANS

The ANS has three principal functions:

1. Regulation of the heart
2. Regulation of the secretory glands
 - salivary
 - gastric
 - sweat
 - and bronchial glands
3. Regulation of smooth muscles,
 - muscles of bronchi
 - muscles of blood vessels
 - muscles of urogenital
 - muscles of GIT

Major function of PsNs;

- Specifically, stimulation of appropriate PsN will cause:
 1. slowing of the heart
 2. increased gastric secretion
 3. emptying of the bladder
 4. emptying of the bowel
 5. focusing of the eye for near vision
 6. constriction of the pupil
- Agents that work by altering parasympathetic nervous system function are used primarily for their impact upon-
 - the gastrointestinal tract
 - the bladder
 - the eye

Major functions of SNS

The main functions of the sympathetic nervous system are:

- A. Regulation of CVS
- B. Regulation of body temperature
- C. Initiation of "fight" or "flight" reaction.

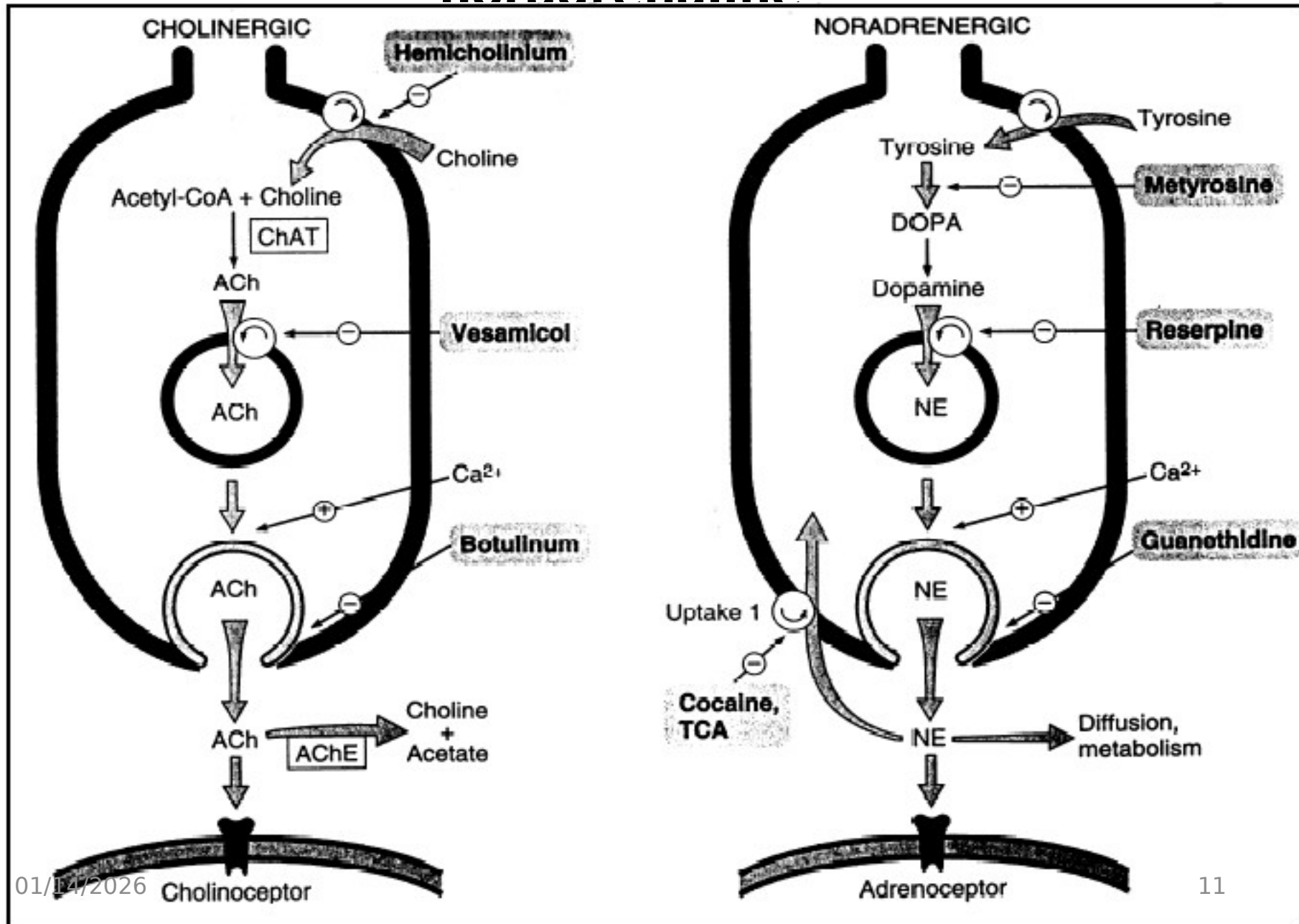
Characteristic features:

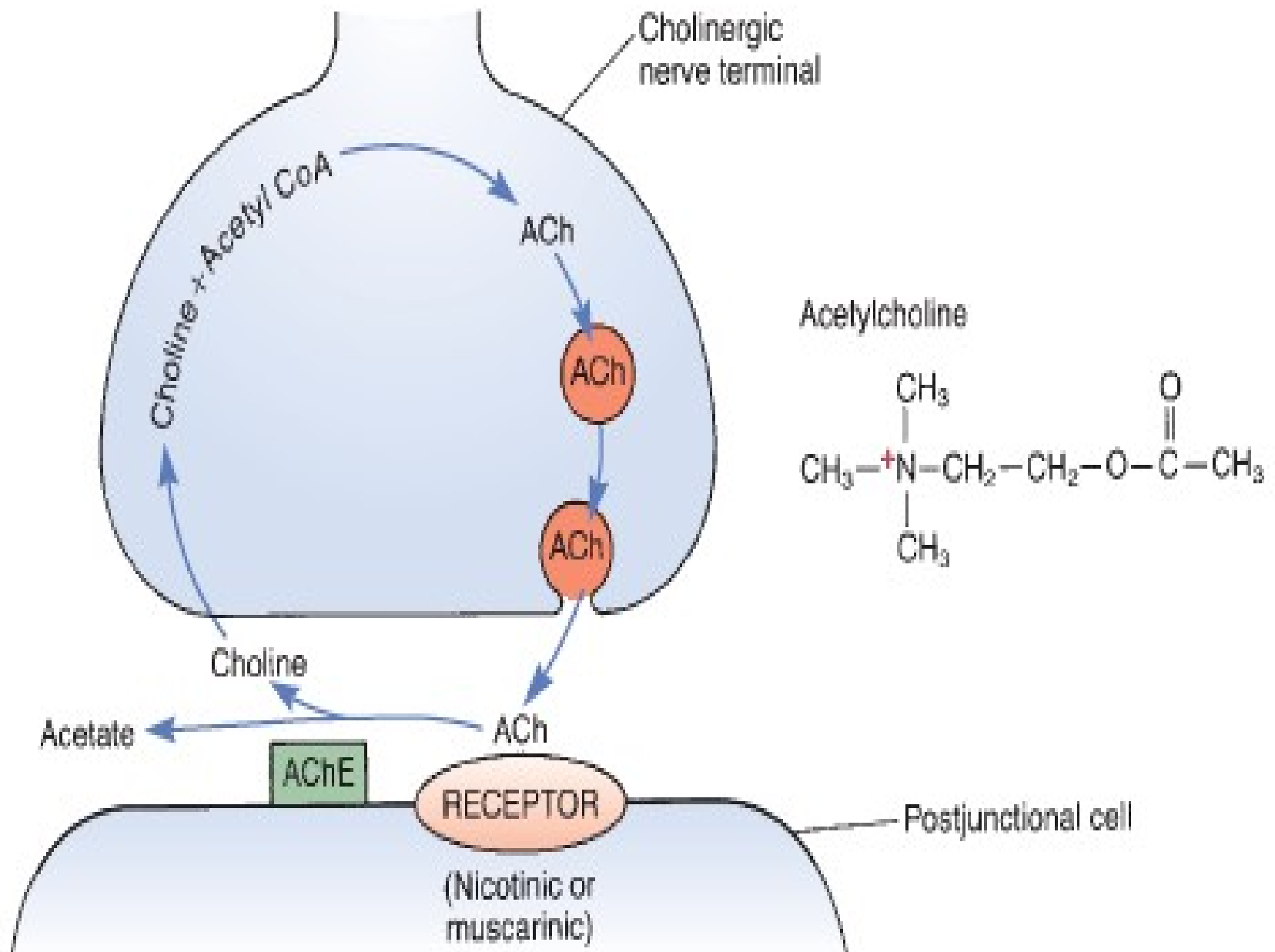
- a) Shunting of blood away from the skin and visceral into skeletal muscles.
- b) Dilation of the bronchi to improve oxygenation
- c) Dilation of the pupil
- d) Mobilization of stored energy (energy expenditure).

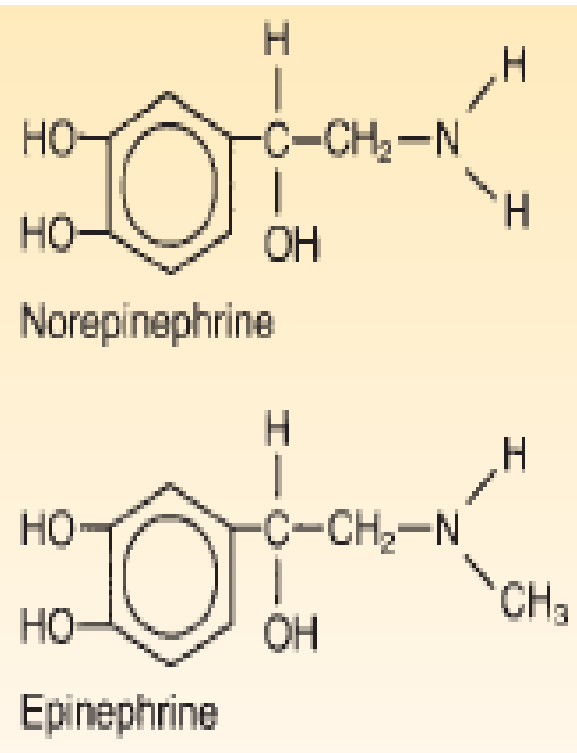
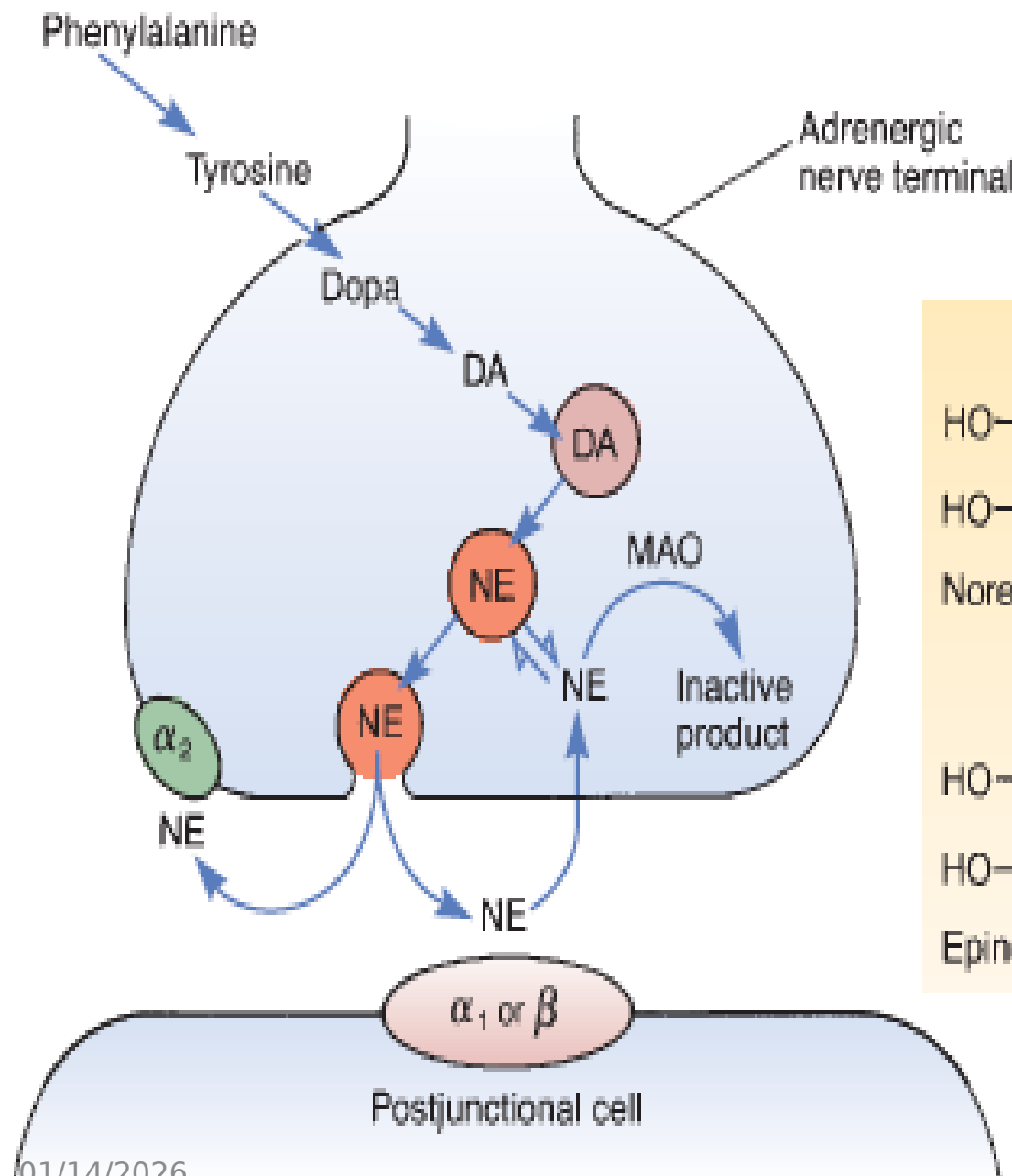
Table 2:1 Functions of sympathetic and parasympathetic system

Organ	Sympathetic systems	Parasympathetic system
Eye	Contraction of iris radial muscle -pupil dilates (mydriasis)	Contraction of iris sphincter muscle-pupil contracts, (myosis)
Ureters & bladder	Relaxes detrusor & contract sphincter - decreased urine output	Contraction of detrusor & relaxation of sphincter
Genitals male	Stimulates ejaculation	Stimulate erection
Lacrimal glands	+ secretion (tear)	+++ Stimulate secretion
Heart	Increased rate & contraction	Decreased rate & contraction
Gastro intestinal	Decrease in muscle motility and tone, contraction of sphincter & inhibits secretion.	Increase muscle motility and tone, relax sphincter & stimulate secretion
Genitals female	Relaxation of uterus	
Arterioles(skin, mucosa, abdominal)	Constriction	Dilatation

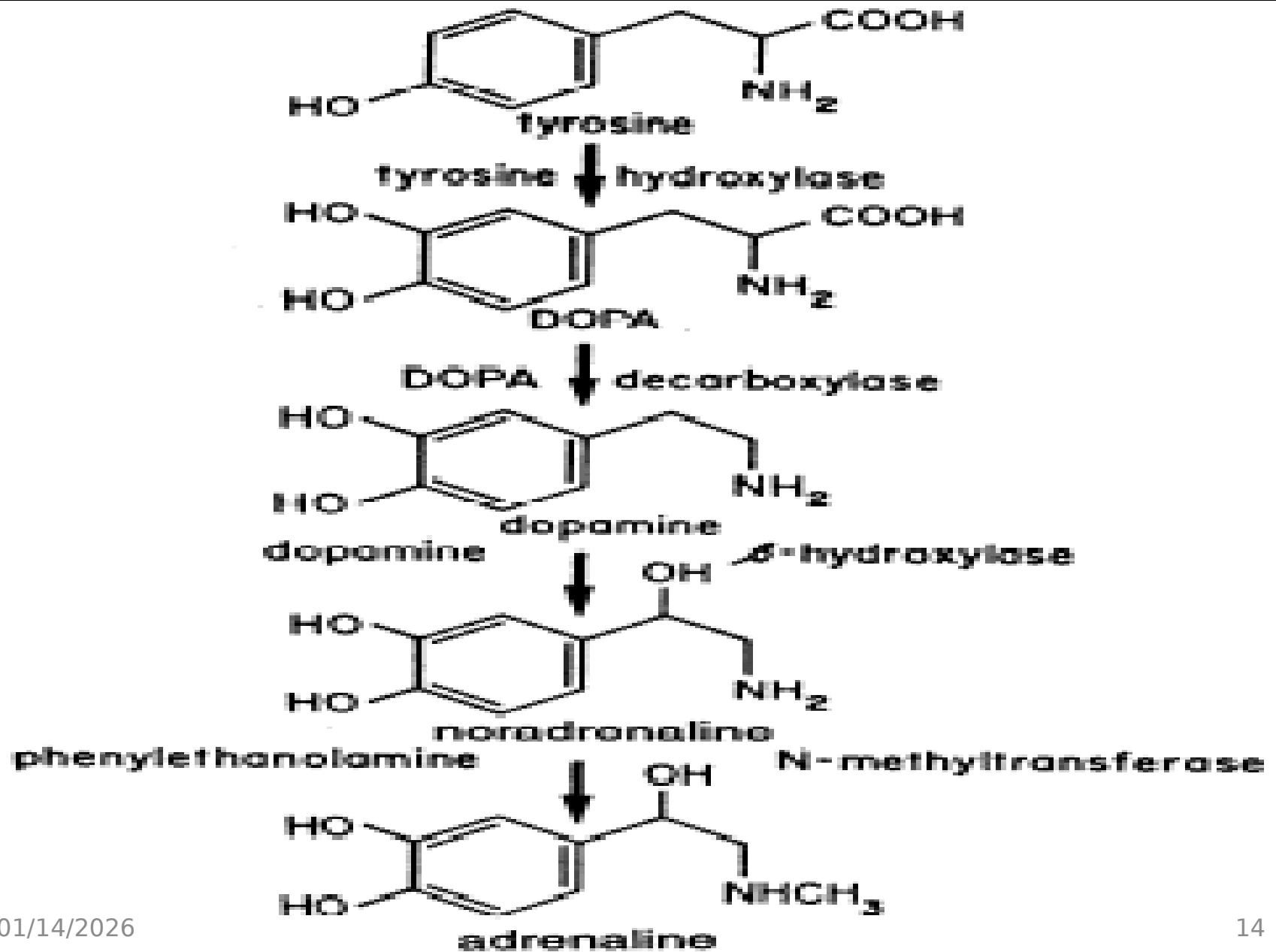
Synthesis and Metabolism of Acetylcholine & noradrenaline





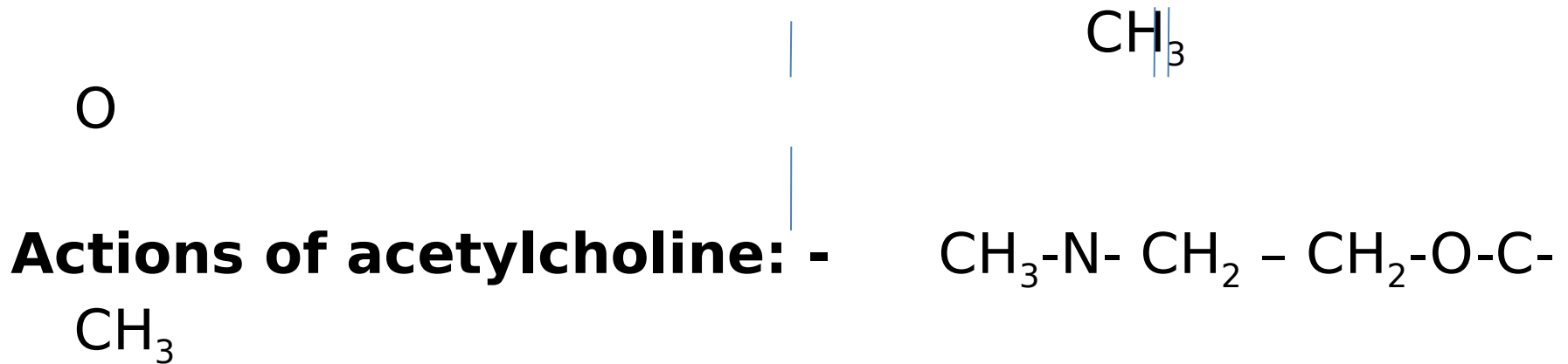


Metabolic pathway of catecholamine synthesis



Cholinergic activating and cholinesterase inhibiting drugs

- **Cholinergic drugs**
- **(Cholinomimetic, parasympathomimetic)**
- These are drugs which produce actions similar to that of Ach, either by directly interacting with cholinergic receptors (cholinergic agonists) or by increasing availability of Ach at these sites (anticholinesterases)



Cholinergic Agonists & Antagonists

Category	Representative Drugs
Muscarinic agonists	Bethanechol, Pilocarpine
Muscarinic antagonists	Atropine
Ganglion stimulating agents	Nicotine
Ganglion blocking agents	Trimethaphan
Neuromuscular blocking agents	d-tubocurarine, succinylcholine
Anticholinesterase agents	Neostigmine, physostigmine

Actions of acetylcholine can be classified as muscarinic or nicotinic;

A. Muscarinic

1. Heart :- bradycardia (rate & force of contraction decreased)

2. Blood vessels (skin of face & neck)

- Dilation – fall in blood pressure

3. Smooth muscles:-

In most organs – contraction

Tone & peristalsis in GIT is increased and sphincters relaxed – abdominal cramp & evacuation of bowel

Peristalsis in ureter is increased – muscle contracts & sphincter relaxes – voiding of bladder

Bronchial muscles constrict – dyspnoea, precipitation of an attack of bronchial asthma.

4. Glands:-

Secretion is increased:- sweating, salivation, lacrymation, tracheo bronchial and gastric secretion

5. Eye:-

Contraction of iris sphincter muscle – **miosis** (constriction of pupil)

Contraction of ciliary muscle – spasm of accommodation, increased out flow facility – reduction in ocular tension.

B. Nicotinic

1. Autonomic ganglia:- both sympathetic & parasympathetic ganglia are stimulated (effect is manifested at higher doses)

2. Skeletal muscles -Contraction (stimulation) ; in high dose, depressed by persistent depolarization.

Cholinergic agonists

Choline esters(synthetic)

Alkaloids(natural compounds)

- Methacholine
- Carbachol
- Pilocarpine
- Bethanechol
- Muscarine

Bethanechol:-

- not hydrolyzed by acetyl choline esterase and so long acting
- no or little nicotinic actions but does have strong muscarinic activity
- major actions are on the smooth musculature of the bladder and GIT.

Therapeutic application:

- ✓ to stimulate contraction of GIT and urinary bladder in certain cases of postoperative abdominal distention, gastric atony and urinary retention in the absence of obstruction;
- ✓ to promote salivation in radiation induced xerostomia;
- ✓ to reduce nausea and vomiting.
- ✓ In paralytic ileus.
- GIT problems (10-25mg, 3-4 times/day PO)
- Urinary retention 5mg sc

Side effects: most are extensions of the pharmacologic effects which includes, sweating, salivation, flushing, decreased blood pressure, urinary urgency, abdominal pain, diarrhea and bronchospasm.

Carbachol:-

- Has both muscarinic & nicotinic actions
- Not destroyed by acetyl cholinesterase→long duration of action
- more pronounced effect in the intestine and urinary bladder.
- Can be given orally or instilled in to the eye.

Therapeutic use: rarely used, except in the eyes as a miotic agent to cause contraction of pupil and a decrease in intraocular pressure.

-Atony of bladder, Paralytic ileus.

Pilocarpine:-

- Exhibits muscarinic activity and is primarily used in ophthalmology

Actions: rapid miosis and contraction of the ciliary muscle (vision is fixed at some particular distance making it impossible to focus (cycloplegia)

Therapeutic use: in glaucoma

- Is the drug of choice in the emergency lowering of intraocular pressure (glaucoma)
- Effective in opening the trabecular meshwork, causing an immediate drop in intraocular pressure as a result of the increased drainage of aqueous humor.
- Action lasts up to 1 day
- It's available as 0.5-4% eye drops

Anti- Choline esteras drugs:- are indirect acting parasympatomimetics

- Are agents which inhibits AchEs and protect Ach from hydrolysis , hence are indirect acting cholinergic drugs.
- This results in the accumulation of acetylcholine in the synaptic cleft
- Provoke a response at all cholinoceptros in the body, including both muscarinic and nicotinic receptors of the ANS.

Classified in to two groups:-Reversible AchE inhibitors
-Irreversible AchE inhibitors

Reversible:- Physostigmine, Neostigmine , Pyridostigmine , Edrophonium

Rivastigmine

Irreversible:-*are poisons rather than drugs. Includes Organophosphates and organochlorides like* **Parathion , Malathion, DDT.**

Physostigmine:-

- It's a substrate for acetylcholine esterase, reversibly inactivates the enzyme
- *Actions:-*
- It stimulates both muscarinic & nicotinic sites of the ANS & nicotinic receptor of neuromuscular junction
- Duration of action: 2-4 hours
- ***Therapeutic use:-***
- Increase intestinal & bladder motility (in atony of either organ)
- Used as nicotinic agent for the treatment of glaucoma
- Treatment of overdose of drugs with anticholinergic drugs such as atropine, tricyclic anti depressants
- ***Adverse effect:-***
- Effect on CNS may lead to convulsions with high doses
- Bradycardia

Neostigmine:-

- Is more polar & therefore does not enter the CNS
- effect on skeletal muscle is greater than that of physostigmine
- used to stimulate the bladder and GI tract in paralytic ileus /atony of bladder (0.5 -1mg sc)
- Antidotes for tubocurarine and other neuromuscular blocking agents
- Major indication is in symptomatic treatment of **myasthenia gravis** (weakening of muscle caused by antibodies to the nicotinic receptor)
- Duration of action 2-4 hours

Adverse effect:-

Generalized cholinergic stimulation such as salivation, flushing, decreased blood pressure, nausea, abdominal pain, diarrhea and broncho spasm

Edrophonium (2mg)

- For diagnosis of myasthenia gravis
- Myasthenia gravis: autoimmune process causes production of antibody that decrease the number of functional nicotinic receptors on the postjunctional end plates.
- Neostigmine and pyridostigmine are used to treat chronic long term myasthenia gravis

Irreversible anticholinesterases

- Bind covalently to acetyl cholinesterase which is extremely stable
- leads to long lasting increase in Ach act all sites
- Extremely toxic & used as nerve agents in military & insecticides
- Easily available and extensively used as agricultural and household insecticides

poisoning by these agents :-

- Initially: miosis, salivation, sweating, vomiting, diarrhea and bronchial constriction, followed by involvement of nervous systems
- Cause persistent depolarization of muscle end plates resulting in blockade of neuromuscular transmission, weakness and paralysis
- Respiratory paralysis (central as well as peripheral)
- Death is generally due to respiratory failure

Treatment

- Maintenance of respiration
- **Atropine** parenterally in large doses for symptomatic treatment.
- Therapy with **pralidoxine** (choline esterase reactivators)

CHOLINOCEPTER BLOCKING DRUGS

- Also called as Cholinergic antagonists
- Bind to cholinergic receptor but do not trigger the usual receptor mediated intracellular effects
- These drugs are classified as:
 1. Antimuscarinic agents
 2. Ganglionic blockers
 3. Neuromuscular blocking drugs
- **Antimuscarinic agents**:- block the muscarinic synapses of the parasympathetic nerves
- **Ganglionic blockers**: block the nicotinic receptors of the sympathetic and parasympathetic ganglia
- **Neuromuscular blockers**:- block the nicotinic receptors at neuro-muscular junctions

Anti-muscarinic agents:-

- Block muscarinic receptors, they do not block the nicotinic receptors;
- have no action at skeletal neuromuscular junctions or autonomic ganglia.

Classification of antimuscarinic agents:

- *Natural alkaloids:* **atropine, hyoscine (scopolamine)**
- *Semi-synthetic derivatives:* **homatropine, ipratropium bromide.**
- *Synthetic compounds:* **tropicamide, propantheline, oxyphenonium.**

Pharmacological actions of antimuscarinic agents (atropine as prototype):-

Can be predicted from the knowledge of parasympathetic responses
Atropine an alkaloid found in *atropa belladonna*.

It blocks all subtypes of muscarinic receptors (central & peripheral)

▪ **CNS:** has an overall CNS stimulant action

▪ **Eye:** result in mydriasis (dilation of pupil)

Unresponsiveness to light & cycloplegia (inability to focus for near vision)

In patients with glaucoma, intraocular pressure may rise dangerously

Gastro intestinal tract:-

- Antispasmodic, reduce activity of GI tract

Urinary systems:-

- Reduce hypermotility of the urinary bladder
- Occasionally used in enuresis (involuntary voiding of bladder)

Cardio vascular:-

- At higher doses increased cardiac rate (tachycardia)

Secretions:-

- Block salivary glands – dry mouth (xerostomia) & swallowing difficulty.
- Block sweat glands elevated body temperature
- Block lacrimal gland, and tracheobronchial secretion
- Secretion of acid, pepsin & mucus is decreased
- Intestinal & pancreatic secretions are not significantly decreased

Therapeutic uses of atropine:-

- Ophthalmic: for diagnostic use in retinal examination.
- Antispasmodic agent: to relax GIT and urinary bladder
- As antidote for cholinergic agonists for Rx. of overdoses of organophosphates (which are found in some insecticides) and some type of mushroom poisoning.
- Anti-secretory agent: to block secretion in the upper and lower respiratory tracts prior to surgery

Pharmacokinetics :- is readily absorbed, partially metabolized by the liver and is eliminated primarily in urine

Adverse effect:-dry mouth, blurred vision, tachycardia, constipation

Presentation:- atropine sulphate 1mg/ml ini 1% eye

Hyoscine (scopolamine)

- It is an alkaloid obtained from *hyoscyamys niger*
- It produces peripheral effects similar to those of atropine
- It has greater action on the CNS

Actions: - the most effective anti-motion sickness drugs available.

Therapeutic use: - anti motion sickness agent, antispasmodic.

- injection, Po & transdermal patch is available.

Phk & adverse effect: similar to atropine

Presentation: buscopan (hyoscine butyl bromide) 10mg tab, 20 mg/ml amp is available, syrup 5mg/ml and oral drops 1mg/ml.

Adverse effects of antimuscarinic drugs

- Mydriasis is used
 - Cycloplegia Motility
 - Poisoned individuals
 - Dry mouth
 - Mydriasis
 - Tachychardia
 - Over dose of atropine & its congeners treated symptomatically by:
 - Physostigmine or Neostigmine
- when antimuscarinic agent to reduce GI secretion/
- Agitation
 - Delirium
 - Hot & flushed skin

Contraindication

- Glaucoma
- Elderly men with prostatic hypertrophy
- Gastric ulcer (they may increase symptoms)

Ganglionic Blockers

- ✓ Act on nicotinic receptor
- ✓ Show no selectivity towards sympathetic or parasympathetic ganglia
- ✓ Responses observed are complex & unpredictable
- ✓ Rarely used therapeutically, & serves as tools in experimental pharmacology

a) Nicotine

- Depending on the dose, nicotine depolarizes ganglia
→ stimulation followed by paralysis
- Stimulatory effect: increase blood pressure & cardiac rate; Increase peristalsis & secretions.

b) Trimethophan

- Competitive nicotinic ganglionic blocker
- Used for the emergency lowering of blood pressure

c) Mecamylamine

- 01/14/2026 • Similar to trimethaphan, but longer duration of action (10hr) & can be taken orally

Neuromuscular blocking drugs

- Ach act at receptors on end plate of neuromuscular junction.
- They are useful during surgery to produce complete muscle relaxation.
- Other muscle relaxants: Diazepam, Dantrolene & Baclofen

1. Non depolarizing (competitive) blockers

-Tubocurarine was used in South America to paralyze game

Mechanism of action: Prevent the binding of Ach

Neuromuscular blocking cont'd

- Therapeutic use: as adjuvant drugs in anesthesia
- Pharmacokinetics
 - All neuromuscular blocking agents are injected i.v.
 - Excreted unchanged in urine

Neuromuscular blocking cont'd

2. Depolarizing agents

- Depolarization of receptor (fasciculation) and continued binding renders the receptor incapable of transmitting further impulse → flaccid paralysis
- Therapeutic use:
- **Succinylcholine** {rapid onset & short duration} is used when rapid endotracheal intubations is needed.
 - Pharmacokinetics: injected i.v; rapidly hydrolyzed by plasmacholinesterase.
 - Adverse effect
 - Hyperthermia
 - Apnea (due to paralysis of diaphragm)

Drugs acting on the sympathetic NS

Over View of Adrenergic Agonists

Adrenergics

- Drugs that stimulate the sympathetic nervous system (SNS)
 - Also known as adrenergic agonists or sympathomimetics
 - Mimic the effects of the SNS neurotransmitters: norepinephrine (NE) and epinephrine (EPI)
-
- The adrenergic agonists can be placed into two major groups:
 1. catecholamine and
 2. non-catecholamine on the basis of

The catecholamine and the non-catecholamine differ from each other in three important respects;

1. oral availability
2. duration of action and
3. ability to influence the CNS

Adrenergic Receptors

- Located throughout the body
- Are receptors for the sympathetic neurotransmitters
- Alpha(α) -adrenergic receptors: respond to NE
- Beta (β) -adrenergic receptors: respond to EPI

Alpha Adrenergic Receptors

- Divided into α_1 and α_2 receptors
- Differentiated by their location on nerves
- α_1 - Located on postsynaptic effector cells (the cell, muscle, or organ that the nerve stimulates)
- α_2 receptors ;
 - Located on pre-synaptic nerve terminals (the nerve that stimulates the effector cells) and Control the release of NT.

Receptor specificity of representative adrenergic agonists;

Catecholamine

Noncatecholamines

<u>Drug</u>	<u>Receptor stimulated</u>	<u>Drug</u>	<u>Receptor stimulated</u>
Adrenaline	$\alpha_1, \alpha_2, \beta_1, \beta_2,$ β_2	Ephedrine	$\alpha_1, \alpha_2, \beta_1,$ β_2
Noradrenaline	$\alpha_1, \alpha_2, \beta_1$	Phenylephrine	α_1
Isoprenaline	$\beta_1, \beta_2,$	Terbutaline	β_2
Dopamine	β_1, DA		

Characteristic responses mediated by adrenoceptors

α_1

- ✓ Vasoconstriction (skin & abdomen)
- ✓ Increases peripheral resistance
- ✓ Mydriasis (eye)
- ✓ Nasal decongestion: Drugs can relieve this congestion by causing α_1 mediated vasoconstriction
- ✓ Increase closure of internal sphincter of bladder
- ✓ Adjunct to local anaesthetics : frequently combined with local anaesthetic to ;
 - delay anaesthetic absorption and prolongs anesthesia
 - reduction in anaesthetic dosage
 - reduce systemic side effects that a local anaesthetic
- ✓ Elevation of blood pressure

Therapeutic applications of Beta₁ stimulation

- a. Treatment of cardiac arrest
- b. Treatment of heart failure
- c. Treatment of shock

Adverse effects of Beta₁ Stimulation

- a) Tachycardia or even arrhythmia
- b) Angina Pectoris

Therapeutic application of Beta₂ Stimulation

- 1. Asthma. Since stimulation of beta₂ receptors in the lung causes bronchodilation.
- 2. Delay of premature labour

Adverse effects of beta₂ stimulation

- Hyperglycaemia only in patients with diabetes.

Mechanism of action of adrenergic agonists

Direct-acting agonists:- act directly on α or β receptors, producing effect similar to adrenaline (epinephrine) or nor-epinephrine e.g. Epinephrine, nor-epinephrine, isoproterenol & phenylephrine.

Indirect-acting agonists:- taken up into the presynaptic neuron and cause the release of nor-epinephrine from the cytoplasmic pools or vesicles of the adrenergic neurons e.g. Amphetamine & tyramine

Mixed -action agonists:- these agents have the capacity both to directly stimulate adrenoceptors and to release NE from the adrenergic neuron e.g. Ephedrine

Direct acting adrenergic agonists

Epinephrine / Adrenaline:-

- ✓ is one of the catecholamines
- ✓ Commonly used in therapy
- ✓ Interacts with both α and β receptors

Actions

Cardiovascular

- ✓ Strengthens the contractility of myocardium (positive inotropic: β_1 action) & increase rate of contraction (positive chronotropic β_1 action)
- ✓ Constricts arterioles in the skin mucous membranes & viscera (α effects) and dilates vessels going to the liver and skeletal muscle (β_2 effects)

Respiratory system

- ✓ bronchodilation by acting directly on bronchial smooth muscle (β_2 action)

Hyperglycemia

- ✓ a significant hyperglycemic effect b/c of increased glycogenolysis in liver (β_2 effect) increased release of glucagons (β_2 effect) and a decreased release of insulin (α_2 effect)
- ✓ Lipolysis- Initiates lipolysis through β -receptors of adipose tissue.

Therapeutic uses Epinephrine/Adrenaline

- In emergency treatment of bronchoconstriction (acute asthma)
 - selective β_2 agonists, such as terbutaline, are favoured in chronic treatment of asthma because of longer duration of action and minimal cardiac stimulatory effect.
- Glaucoma:- it reduces the production of aqueous humor by vasoconstriction of the ciliary body blood vessels (2% epinephrine solution)
- Anaphylactic shock:- it is the drug of choice from the treatment of type1 hypersensitive reaction in response to allergens.
- In anesthetics:- it increase the duration of local anesthetics by producing vasoconstriction at the site of injection.

Pharmacokinetics

- *Absorption:* Adrenaline is administered topically, by injection and by inhalation, the drug is not administered by mouth.
- *Inactivation:* Adrenaline has a short plasma half-life because of two processes:
 - a. Enzymatic inactivation and
 - b. Uptake into adrenergic nerves

Adverse effects

1. Hypertensive crisis
2. Arrhythmias
3. Angina
4. Necrosis
5. Hyperglycemia

Direct acting cont'd

Nor epinephrine

- α -adrenoceptor is most affected
- Vasoconstriction; -ve chronotropic effect (baroreceptor reflex); +ve inotropic effect
- Therapeutic use: shock (dopamine is better)

Isoproterenol

- Stimulates β_1 & β_2 adreneceptor
- action on CVS : increase rate & force of contraction; ↓ se peripheral resistance
- Action on Pulmonary: Branchodilation

Dopamine

- D1 & D2 receptor, B1-receptor
- **Action**
CVS: Inotropic & chronotropoc effect at high dose → Vasoconstriction (α -receptor)
Renal & visceral: ↑ blood flow
- **Therapeutic use:** Shock (drug of choice)
- **Adverse effect:** Same effect as sympathetic stimulation

Direct acting cont'd

Phenylephrine

- Non-catecholamine
- Favors α_1 -receptor
- Vasoconstrictor, induces reflex bradycardia (parentally)
- Nasal decongestant (topically)

Clonidine

- α_2 -agonist
- Lower BP by acting on centrally located α_2 receptors (inhibition of sympathetic vasomotor centers) and mainly used for treatment of HTN.

Direct acting cont'd

Terbutaline

- Selective β_2 agonist, longer duration
- Used as a bronchodilator for asthma & reduce uterine contraction in pregnancy

Albuterol /Salbutamol

- Similar to terbutaline
- Used in the treatment of Asthma

INDIRECT ACTING ADRENERGIC AGONISTS

- ✓ Cause norepinephrine release from presynaptic terminals

Amphetamine

- central stimulatory action
 - used in hyperactivity in children, narcolepsy & appetite control

Tyramine

- not clinically useful
- can enter the nerve terminal & displace stored norepinephrine

MIXED ACTION ADRENERGIC AGONIST

- Induce release of norepinephrine & activate adrenergic receptor

Ephedrine

- releases norepinephrine
- Stimulates both α & β receptors
- Ephedrine is poor substrate for COMT & MAO
- Eliminated unchanged
- Raises systolic & diastolic BP
- Produces bronchodilation
- Used prophylactically in chronic treatment of asthma.
- Increases alertness, decreases fatigue
- Used to treat nasal congestion.

01/14/2026 Metaramil- used to treat shock & acute hypotension

ADRENERGIC ANTAGONISTS

Adrenergic blocker

α -blockers - Dexazosin
Phenoxybenzamine
Phentolamine
Prazosin

- Metoprolol

Terazosin

Nadolol

- Pindolol

Propranolol

β - blockers - Acebutolol
- Atenolol
- Labetalol

-

-

- Timolol

α -adrenergic blocking agents

- ✓ Decrease peripheral vascular resistance
- ✓ Reflex tachycardia

1. Phenoxybenzamine

- Nonselective, linking covalently (irreversibly) to both α_1 & α_2 - receptors
- CVS – Prevents vasoconstriction, reflex tachycardia
- Therapeutic uses: pheochromocytoma
 Raynaud's disease
- Adverse effect:
 postural hypotension, Nausea & vomiting
 Nasal stuffiness Inhibit ejaculation

 Induce tachycardia

α -adrenergic blocking cont'd

2. phentolamine

- Competitive blocker of α_1 & α_2 -receptor
- Duration of action 4hrs
- Used in diagnosis of pheochromocytoma (a tumor of the adrenal gland)
- Trigger arrhythmias & anginal pain, contraindicated in patients with decreased coronary perfusion.

3. Prazosin, terazosin & doxazosin

- Selective competitive blockers of α_1 -receptor, used in elevated BP.
- doxazosin is longest acting
- First dose effect: adjust the first dose [divide & give the drug at bed time]
- Alternative to surgery in patients with symptomatic benign hypertrophy
- Adverse effect: Dizziness, nasal congestion, headache drowsiness & orthostatic hypotension.

β -adrenergic blocking agents

-The names of all β blockers end in “-olol” except for labetalol

- **β 1-selective:**

- Metoprololol,
- Acebutolol
- atenolol
- betaxolol
- esmolol

- **β -non selective blockers:**

- Propranolol
- Pindolol
- Timolol

Therapeutic application of beta blockade

- a) Hypertension
- b) Angina pectoris
- c) Cardiac Arrhythmias
- d) Glaucoma

Adverse Effects of Beta₁ Blockade

- 1) Bradycardia
- 2) Reduction of cardiac output
- 3) Production of congestive heart failure

Adverse Effects of Beta₂ Blockade

- a. Bronchial constriction
- b. Inhibition of Glycogenolysis

a. Propranolol

- Prototype β -adrenergic antagonist blocks β_1 & β_2 -receptor
- Has negative inotropic & chronotropic effect
- Peripheral vasoconstriction
- Bronchoconstriction
- Disturbances in glucose metabolism [decreased glycogenolysis & glucagon]

Therapeutic effect

Hypertension

Glaucoma

Hyperthyroidism

Angina pectoris

Myocardial infarction

β-adrenergic blocking cont'd

- Adverse effect – Bronchoconstriction
Arrhythmias
Disturbances in metabolism
- Drug interaction
 - Cimetidine
 - Furosemide } Potentiate its antihypertensive effect
 - Chlorpromazine
 - Barbiturate }
Phenyton } mitigate its effect
Rifampin }

β-adrenergic blocking cont'd

b. timolol & nadolol

- Nonselective β-antagonists, more potent than propranolol
- Timolol reduces the production of aqueous humor in the eye & used in the treatment of chronic open angle glaucoma (timolol eye drop)

c. Acebutolol, atenolol, metoprolol & esmolol_

- Selective β₁-antagonist
- Lower blood pressure in hypertension
- Useful in hypertensive patients.