

Muscarinic ACh receptors (mAChRs) Location	
Muscarinic 1 (M1)	Ganglia cells
Muscarinic 2 (M2)	Cardiac muscle
Muscarinic 3 (M3)	Sweat glands
Muscarinic 4 & 5 (M4 & M5) are NOT very important in this module.	

Muscarinic Effects on Organ		
Heart	↓ HR	M2
Eye (circular musc.)	Pinpoint pupil	M2 & M3
Eye (ciliary musc.)	Contract	M3
Vascular musc.	Relax	M3 (NO)
Lungs (Broncho musc.)	Contract	M3
GI-tract	↑ motility	M3
Genito-urinary musc.	Contract	M3
Sweat & Salivary Gland	↑ excretion	M3

Parasympathetic Agonist Effects	
Heart	↓ CO = ↓ contraction & ↓ AV conduction speed = BRADYcardia
Vascular musc.	Vasodilation via (NO) production
Smooth musc.	↑ intestine & bladder tone (motility) & ↓ sphincter tone
Eye	↑ contraction of sphincter (miosis) & ciliary muscle (NEAR vision)
Glands	↑ sweating, saliva, gastric acid secretion
Parasympathetic Agonist = Activation = INactivate sympathetic actions (Think OPPOSITE of ALL sympathetic activation)	

Parasympathetic Antagonist Effects	
Heart	↑ CO = ↑ AV node firing = ↑ HR = TACHYcardia
Vascular musc.	NO EFFECT b/c NO innervation
Smooth musc.	Relaxation = ↓ GI & Urinary tract contraction
Eye	Pupil dilation & Loss of NEAR focus (FAR vision)
Glands	↓ sweat, saliva, gastric acid secretion
Central NS (CNS)	Belladonna Symptoms
Belladonna Symptoms: "mad as a hatter, red as a beet, blind as a bat, hot as hell, dry as a bone"	

Eye Terminology	
Miosis	Paralysis of ciliary muscle (loss of accommodation, ability to focus)
Mydriatic	Contraction of pupil (leads to pinpoint pupil, ie. Ach)
Cycloplegia	Relaxation of pupil (dilation); Atropine: belladonna compound)

Antagonist: Parasympatholytic Agents	
Antimuscarinic	Block ACh in Parasymp. Effector Junctions
Antinicotinic	Block ACh in Ganglia (Para- & Sympathetic; NN/N1)
Antinicotinic	Block ACh in NMJ (skeletal muscle relaxant, NM/N2)
Antinicotinic	Block ACh in Ganglia (both Para- & Sympathetic, NN/N1)



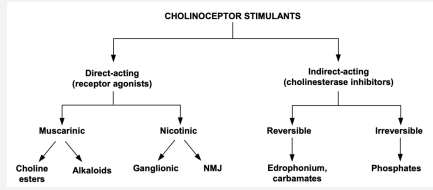
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Published 22nd February, 2023.  
Last updated 22nd February, 2023.  
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### Agonist: Parasympathomimetic Agents



Directly-Acting: Combine with mACh and/or nAChs cholinceptors receptor directly → Direct activation.

### Parasympathetic Agents

Agonist (1) Acetylcholine, ACh (2) Bethanecol (3) Pilocarpine (4) Methacholine

Antagonist (- tropine) (1) Atropine (2) Scopolamine (3) Homatropine (4) Benzotropine (5) pirenzepine

### Directly-Acting PNS Agonist

mAChs Choline Ester Acetylcholine; Methacholine  
Carbachol; Bethanechol

Alkaloids Muscarine; Pilocarpine

nAChs Ganglionic Stimulants Acetylcholine; Nicotine  
Varenicline (partial)

Choline Ester: Short-acting; stay in blood stream; NO (X) BBB

Alkaloids: (X) BBB

### mAChs Agonists Uses

Acetylcholine Ophthalmic (brief miosis)  
Methacholine Belladonna poisoning; Urinary retention  
Bethanechol Reverse post-op GI depression  
Pilocarpine (alkaloid) DOC for Glaucoma

### Acetylcholinesterase Inhibitors (AChEIs)

Reversible Edrophonium (Tensilon) For myasthenia gravis (extreme muscle weakness)

Irreversible Neostigmine NO (X) BBB; For myasthenia gravis & ileus (comp. Inhibs)

Physostigmine (X) BBB; For glaucoma and for treatment of belladonna poisoning

Pyridostigmine Myasthenia gravis

Amibenonium Myasthenia gravis

Slow Reversible Echothiophate Glaucoma

Organophosphate insecticides, nerve gases DFP N/A

Inhibits AChE at both mAChs & nACh via ↑ synaptic concentration & half-life of Ach.

### Symptoms from Excess Cholinergic activity

General (SLUDE) Salivation, Lacrimation, Urination, Diarrhea, Emesis

Muscarinic (SLUGBAM) Salivation/Sz, Lacrimation, Urination, GI distress (D/V), Bronchoconstriction, Abd. cramps, Miosis

Nicotinic (MTWThF) Mydriasis, Tachycardia, Weakness (muscle paralysis), hyperthermia, Fasciculation

Muscarinic (SLUGBAM) Salivation/Sz, Lacrimation, Urination, GI distress (D/V), Bronchoconstriction, Abd. cramps, Miosis

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