



Lecture 2

Pharmacology of drugs acting on the eye

- Additional Notes
- **Important**
- Explanation –Extra-

For any correction, suggestion or any useful information do not hesitate to contact us: Pharmacology434@gmail.com

Drugs can be delivered to ocular tissue as:

Locally (Topically): More common

Eye drops

- Eye drops- **most common**
- one drop = 50 µl
- Their contact time with the tissue is low → **should be used several times** (every 4 hours mostly)

Ointments
مراهم

Increase the contact time of ocular medication to ocular surface thus **better effect**
Disadvantage: The drug has to be **high lipid soluble** to have the maximum effect as ointment

Peri-ocular injection

- Sub-conjunctival, retro-bulbar (behind the eyeball) or peri-bulbar (around eye ball).
- Reach behind iris-lens diaphragm **better than** topical application
- Bypass the conjunctival and corneal epithelium which is good for **drugs with low lipid solubility** (e.g. penicillin's)
- **Steroid and local anesthetics** can be applied this way

Intraocular injection

Intra-cameral (inside chamber) or **intra-vitreous** (intra-vitreous):

- **Intra-cameral acetylcholine** or **lidocaine** during cataract surgery
- **Intra-vitreous antibiotics** in cases of endophthalmitis (inflammation of internal coats of eye)
- **Intra-vitreous steroid** in macular edema

Sustained release preparations

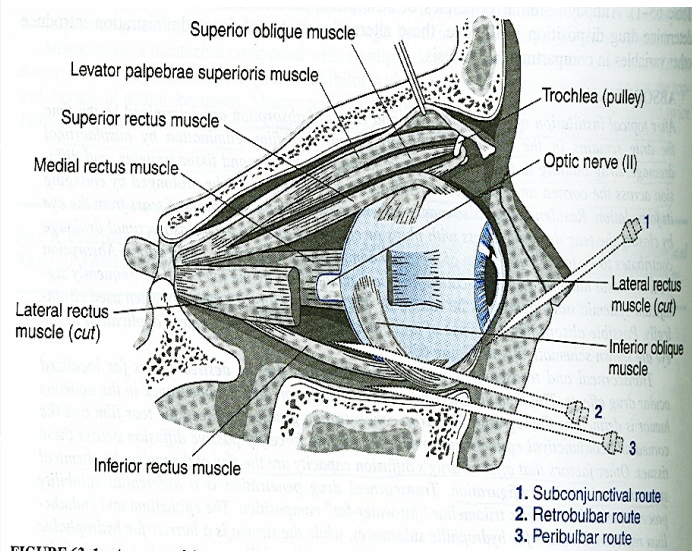
Systemically

Orally

IV

Factor influencing systemic drug penetration into ocular tissue:

1. **lipid solubility of the drug:** more penetration with high lipid solubility.
2. **Protein binding:** more effect with low protein binding.
3. **Eye inflammation:** more penetration with ocular inflammation.



Actions of Sympathetic N.S

Receptor	Organ	Action
α_1 (constriction)	Eye	Dilates pupils by Contraction of dilator Pupillae (Active mydriasis).
	Blood vessels	Constriction of BV in skin & peripherals (except the heart and skeletal muscle).
	GI	Sphincter : Constriction (retention).
	GU	<ul style="list-style-type: none"> - Urinary sphincter : Constriction. - Uterus, pregnant : Contraction. - PENIS : Ejaculation.
	Secretory glands	Sweat : Localized secretion.
α_2	Secretory glands	<ul style="list-style-type: none"> - Intestinal : Inhibition. - Salivary glands: ↓ Salivation.
	Metabolism	<ul style="list-style-type: none"> - Pancreas (b cells) : ↓ insulin release. - Adrenergic terminals : inhibits NE release.
β_1	Heart	<ul style="list-style-type: none"> - ↑ heart rate (chronotropic). - ↑ Force of contraction (Inotropic). - ↑ Conduction velocity and automaticity (Dromotropic).
	Blood vessels	- ↑ systolic
	Kidney	- ↑ renin release.
β_2 (Relaxation)	Eye	Ciliary muscle : Relaxation. (<u>accommodation for far vision</u>)
	Lungs	Bronchial muscle : Relaxation (Bronchodilatation).
	Blood vessels	<ul style="list-style-type: none"> - Relaxation of BV (Vasodilatation) → Coronary & skeletal. - Abundant on blood vessels serving the heart, liver and skeletal muscle.
	GI	↓ motility and tone.
	GU	<ul style="list-style-type: none"> - Bladder wall : Relaxation. - Uterus, pregnant : relaxation (Tocolysis).
	Metabolism	<ul style="list-style-type: none"> - Skeletal muscle : Glycogenolysis , ↑ contractility . - Liver : ↑ Glucose.
β_3	Fat cells	Lipolysis.

RECALL

Autonomic Nerve supply of the Eye

Parasympathetic N.S.

- Constriction of the pupillary sphincter muscle (**miosis**)
- Contraction of the ciliary muscle (**accommodation for near vision**).
- **Decrease in intraocular pressure ↓ IOP.**
- Increases aqueous outflow through the trabecular meshwork into canal of Schlemm by ciliary muscle contraction.
- Increased lacrimation
- Conjunctival Vasodilatation

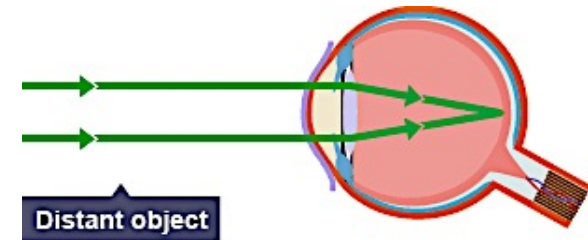
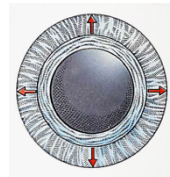
Sympathetic N.S.

- Contraction of dilator Pupillae (**Active mydriasis**) $\alpha 1$
 - Mydriasis mean the iris go to the back.
- Relaxation of ciliary muscles (**accommodation for far vision**) $\beta 2$
- Increase in intraocular pressure
- Lacrimation $\alpha 1$
- **Vasoconstriction** of conjunctival blood vessels $\alpha 1$
- α & β receptors in the blood vessels of the ciliary processes → help in regulation of aqueous humour formation.

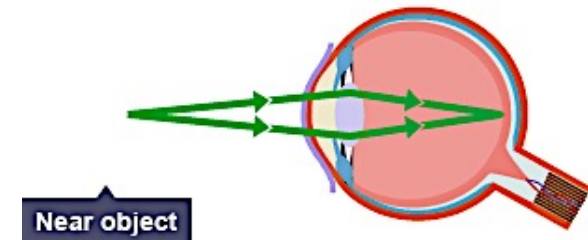
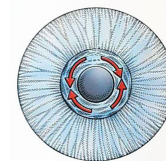
Eye	Parasympathetic N.S.	Sympathetic N.S.
Iris: 1- radial muscle. 2- circular muscle.	1. No effect 2. Contraction (miosis) M3	1. Contraction (Mydriasis) $\alpha 1$ 2. No effect
Ciliary muscle	Contraction M3	Relaxation $\beta 2$
Accommodation	for near vision	for far vision
Conjunctival blood vessels	Conjunctival Vasodilatation	Conjunctival Vasoconstriction

Accommodation

Mydriasis



Miosis



Circular muscle it receives parasympathetic action (**miosis**)
radial muscle receive sympathetic action (**mydriasis**).

Drugs acting on parasympathetic system

		Cholinergic agonists		Cholinergic antagonists (Muscarinic antagonists)		
		Direct agonists (prevent breakdown of ACH)	Indirect acting agonists (anticholinesterases)	Natural alkaloids	Synthetic atropine substitutes	
Drugs		<ul style="list-style-type: none"> Methacholine Carbachol Pilocarpine (1st line in open angle glaucoma) 	Reversible: Physostigmine, demecarium Irreversible: Ecothiophate, Isoflurophate	<ul style="list-style-type: none"> Atropine: 7-10 days. Scopolamine (hyoscine): 3-7 days. 	Homatropine	1-3 days
					Cyclopentolate	24 hours
					Tropicamide	6 hours
USES		1. Glaucoma (open and closed angle) 2. Counteract action of mydriatics (after fundus examination) 3. To break iris-lens adhesions (in inflammation) 4. in accommodative esotropia الحول (Physostigmine, ecothiophate, Isoflurophate) 5. Induction of miosis in surgery (Carbachol & Methacholine)		<ul style="list-style-type: none"> To prevent adhesion in uveitis & iritis Fundusoscopic examination of the eye (Passive Mydriasis → due to relaxation of circular muscles) Measurement of refractive error 		
C/I		Bronchial asthma, Peptic ulcer, Coronary vascular disease, Incontinence سلس البول, Intestinal obstruction		<ul style="list-style-type: none"> Glaucoma (angle closure glaucoma). Tachycardia, Prostate hypertrophy in old patients. Constipation, paralytic ileus. 		
Side effects		<ul style="list-style-type: none"> Systemic: Lacrimation, salivation, sweating, perspiration, bronchial constriction, urinary urgency, nausea, vomiting, and diarrhea. CNS effects: high doses (physostigmine & pilocarpine). Ocular side effects: diminished vision (myopia), headache, cataract, miotic cysts, and rarely retinal detachment. 		<ul style="list-style-type: none"> Cycloplegia (loss of near accommodation) → due to relaxation of ciliary muscles → Loss of light reflex. blurred vision, tachycardia, constipation, urinary retention, dryness of mouth, dry sandy eyes, fever CNS effects: sedation, hallucination, excitation (toxic dose). 		

Drugs acting on sympathetic system

Adrenergic agonists

Although they cause mydriasis, they treat only open angle glaucoma by \uparrow uveoscleral outflow of aqueous humor

	Non-selective agonists	Selective α_1 agonists	Selective α_2 agonists	β blockers
Drug	<ul style="list-style-type: none"> Epinephrine. Dipivefrin (pro-drug of epinephrine). 	Phenylephrine	Apraclonidine (eye drops)	<ul style="list-style-type: none"> Non-selective: timolol, carteolol Selective β_1: betaxolol "cardioselective"
MOA	\uparrow uveoscleral outflow of aqueous humor	Mydriasis (<u>without cycloplegia</u>), <u>decongestant</u>	<ul style="list-style-type: none"> \downarrow production of aqueous humor, and \uparrow uveoscleral outflow of aqueous humor 	Act on ciliary body to \downarrow production of aqueous humor
Uses	<ul style="list-style-type: none"> Used locally as eye drops open angle glaucoma 	<ul style="list-style-type: none"> Funduscopy examination of the eye To prevent adhesion in uveitis & iritis Decongestant in minor allergic hyperemia of eye. 	<ul style="list-style-type: none"> open glaucoma treatment. prophylaxis against IOP spiking after glaucoma laser procedures. 	<ul style="list-style-type: none"> Given topically as eye drops Open angle glaucoma Advantage: can be used in patients with hypertension
Side effect	headache, arrhythmia, increased blood pressure	<ul style="list-style-type: none"> May cause significant increase in blood pressure Rebound congestion precipitation of acute angle-closure glaucoma in patients with narrow angles. 	headache, dry mouth, fatigue, Lethargy, bradycardia, and hypotension.	<ul style="list-style-type: none"> Bronchospasm (less with betaxolol) Cardiovascular (bradycardia, arrhythmia; hypotension, asystole, syncope) CNS effects (depression, weakness, fatigue).
C/I	Narrow angles \rightarrow may precipitate closed angle glaucoma.	-	-	asthmatic patients or patients with CVS disorders.

Drugs used in different medical ophthalmological requirements

Drugs used for glaucoma.

Drugs used for inflammatory conditions.

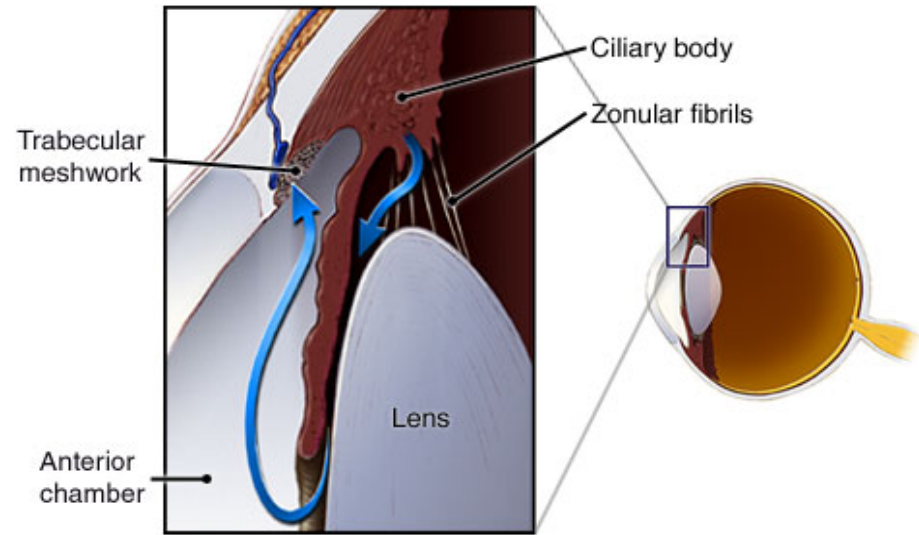
Drugs used for allergies.

Drugs used in infections of eye.

Drugs for diagnostic purposes.

Drugs used for other diseases in the body producing significant harmful effect on the eye.

Flow of Aqueous Humor: A Closer Look at the Trabecular Meshwork



In order to understand the two subtypes of the disease that are the focus of today's case, we must understand the dynamics of aqueous humor production and flow. Disruption of this process can result in elevated IOP and contribute to the pathogenesis of glaucoma.

The aqueous humor is secreted by the Ciliary body. Produced by a combination of active transport of ions and ultrafiltration of interstitial fluid.

The fluid flows over the surface of the lens, out through the pupil into the anterior chamber. Flows through the trabecular meshwork into Schlemm's canal and is collected in the scleral veins.

Seeing this flow pattern, you can imagine how problems can occur and result in accumulation of fluid and elevated pressure.



[Normal Aqueous Drainage + Open-Angle Glaucoma + Angle-Closure Glaucoma.](#)

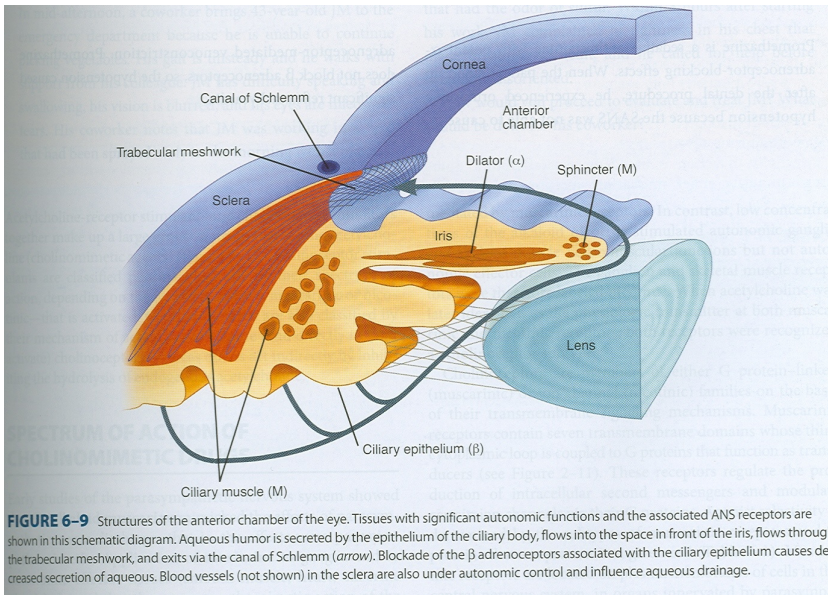
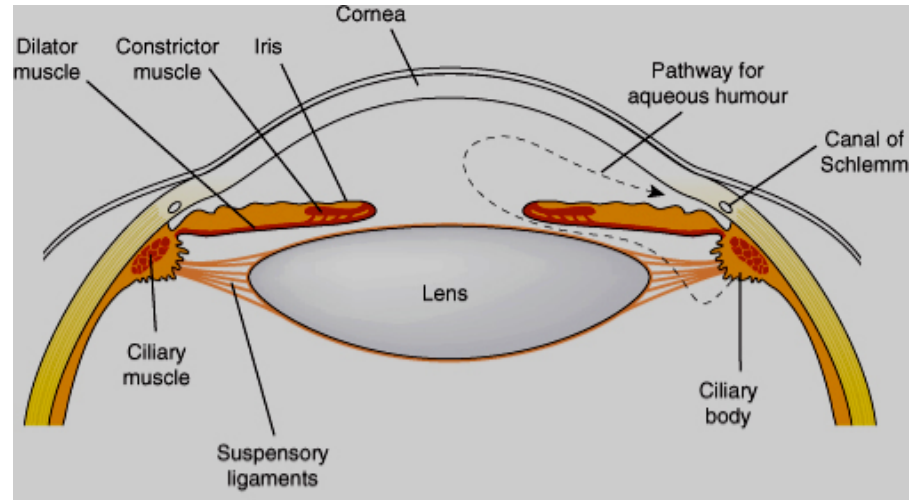


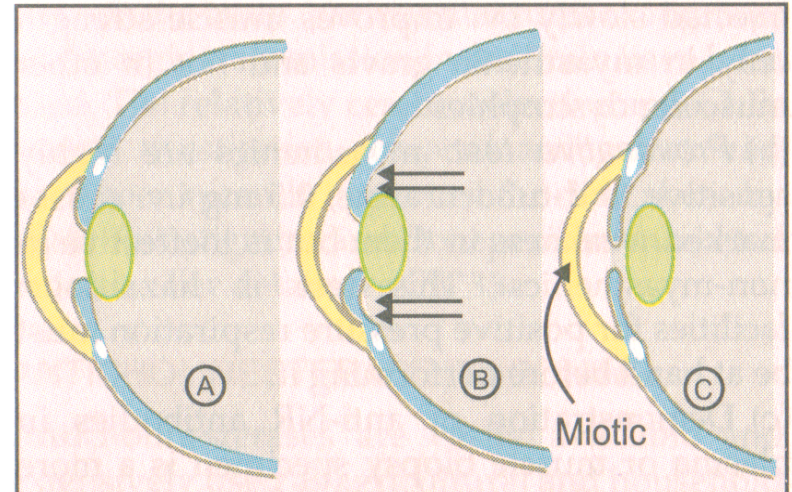
FIGURE 6-9 Structures of the anterior chamber of the eye. Tissues with significant autonomic functions and the associated ANS receptors are shown in this schematic diagram. Aqueous humor is secreted by the epithelium of the ciliary body, flows into the space in front of the iris, flows through the trabecular meshwork, and exits via the canal of Schlemm (arrow). Blockade of the β adrenoceptors associated with the ciliary epithelium causes decreased secretion of aqueous. Blood vessels (not shown) in the sclera are also under autonomic control and influence aqueous drainage.



The aqueous humor is secreted by the epithelium of ciliary body. Produced by a combination of active transport of ions and ultrafiltration of interstitial fluid. The fluid flows over the surface of the lens, out through the pupil into the anterior chamber. Flows through the trabecular meshwork into Schlemm's canal and is collected in the scleral veins.

Development of angle closure glaucoma and its reversal by miotics

- A. Mydriasis occurs in an eye with narrow iridocorneal angle** and the iris makes contact with the lens blocking passage of The aqueous from the posterior to the anterior chamber.
- B.** Possibly builds up behind the iris which bulges forward and closes the iridocorneal angle thus blocking aqueous outflow.
- C. Miotic makes the iris thin and pushes it away from the lens removing the pupillary block and restoring aqueous drainage.**



- Increase in lacrimation by alpha receptors.
- Increase in aqueous flow by beta receptor by increase the drainage or by decrease the production (beta antagonist can reduce the production because it involve the receptor in blood vessels for this it uses to treat glaucoma.)

Treatment of open angle glaucoma (chronic)

-The problem in open angle is the increase of production of aqueous humor.

Goal : to **decrease IOP**.

How? 1-Decreasing production of aqueous humor. 2-Increasing outflow of aqueous humor.

- Beta blockers.
- Alpha-2 agonists.
- **Carbonic anhydrase inhibitors.**
- **Prostaglandins**
- Adrenergic agonists, nonspecific
- Parasympathomimetics.

Prostaglandins and Beta blockers are the most popular

	Carbonic anhydrase inhibitors e.g. acetazolamide (oral), dorzolamide (topical)	Prostaglandin analogues E.g. latanoprost, travoprost
Mechanism	↓ production of aqueous humor by blocking carbonic anhydrase enzyme required for production of bicarbonate ions (transported to posterior chamber, carrying osmotic water flow).	<ul style="list-style-type: none"> • increase uveoscleral aqueous outflow. • Latanoprost is preferred due to lesser adverse effects. • they have replaced beta blockers. • -They are used topically as eye drops & <u>once a day.</u>
Uses	open angle glaucoma.	
Side Effects	Myopia, malaise, anorexia, GI upset, headache Metabolic acidosis, renal stone Bone marrow suppression “aplastic anemia” (Usually this side effect happen in case acetazolamide in oral way)	<ul style="list-style-type: none"> • pigmentation of the iris (heterochromia iridis) • Intraocular inflammation • Macular edema.
Contraindication	Sulfa allergy, pregnancy	

Treatment of narrow closed angle glaucoma (acute)

- **Acute, painful** increases of pressure due to occlusion of the outflow drainage pathway
- Emergency situation that require treatment before surgery (**Iridectomy**)

The use of drugs is limited to :

- **Oral Acetazolamide**
- **Topical cholinomimetics** e.g.: pilocarpine
- **Osmotic agents:** hypertonic solution(Mannitol, Glycerol).
- **Analgesics:** pethidine or morphine (for pain).
 - Closed angle glaucoma has very sever pain (acute), the drugs aren't enough for treatment, so we give them to the patient until having the surgery.
 - Osmotic means drugs extracted from sugar like mannitol or glycerol.

Osmotic agents

Mechanism

can **rapidly** lower IOP by decreasing vitreous volume.

- **Glycerol 50% syrup**, orally (cause nausea, hyperglycemia).
- **Mannitol 20% IV** (cause fluid overload and not used in heart failure).

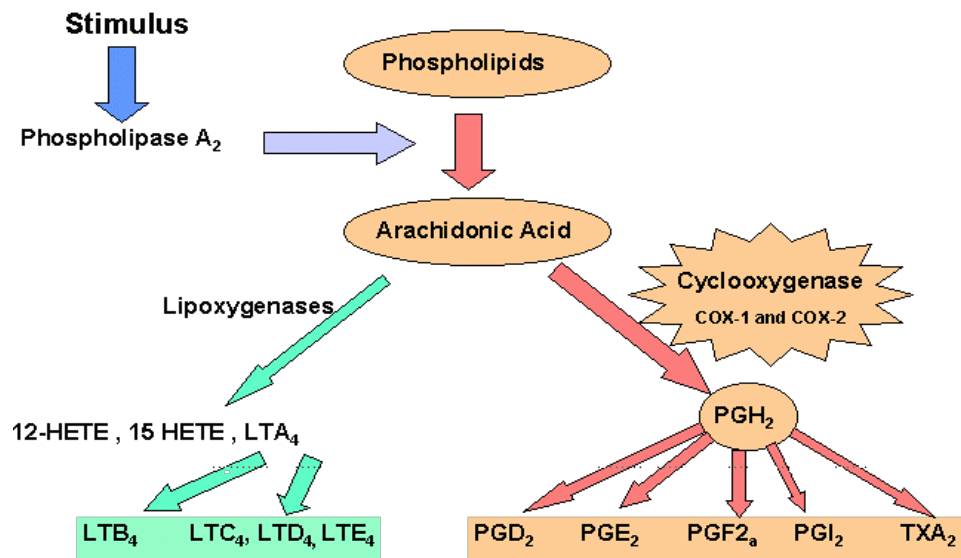
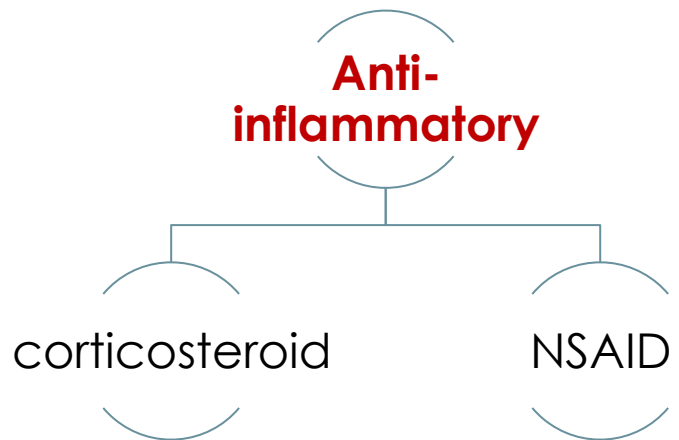
Side effects

Diuresis, circulatory overload, pulmonary edema and heart failure, central nervous system effects such as seizure, and cerebral hemorrhage.

Notes

used only in **acute situations** to temporarily reduce high IOP until more definitive treatments can be rendered.

Treatment of narrow closed angle glaucoma (acute).. continue



	Corticosteroids	NSAID
MOA	inhibition of arachidonic acid release from phospholipids by inhibiting phospholipase A ₂ .	inhibition of cyclo-oxygenase
Uses	<p>1-Topical: E.g. prednisolone, dexamethasone, hydrocortisone. Uses: anterior uveitis, severe allergic conjunctivitis, scleritis, prevention and suppression of corneal graft rejection.</p> <p>2-Systemic: E.g. prednisolone, cortisone. Uses: posterior uveitis, optic neuritis.</p>	post-operatively, mild allergic conjunctivitis, mild uveitis, cystoid macular edema, preoperatively to prevent miosis during surgery
Side effects	<ul style="list-style-type: none"> - Glaucoma, cataract, mydriasis. - Suppression of pituitary-adrenal axis. - Hyperglycemia, Osteoporosis. - Peptic ulcer, Psychosis, susceptibility to infections. 	stinging لاذع
Notes	<p>Side effects: Hypertension, high body weight, inhibition for immune.</p> <p>Contraindication: on diabetic and children (better to be given by inhalation than orally.)</p>	Its mild if I want something strong I give corticosteroid

Harmful drugs for the Eye

1- Drugs that ↑ IOP:

- Mydriatic cycloplegics, tricyclic **antidepressants**.
- Chronic **steroid** use.

2- Cataractogenic drugs: **steroids**, heavy metals...

3- Drug-induced retinopathies: ethanol, methanol.

4- O₂ : 40 % for prolonged periods in premature infants causes **Retrolental fibroplasia** (abnormal proliferation of fibrous tissue immediately behind the lens of the eye, leading to blindness) → (Caused by disorganization growth of blood vessels when infants are given O₂ in case of having immature lungs).

5- Drugs causing corneal deposits:

- **Amiodarone** , **digitalis**, **chloroquine** (Chloroquine is anti-malarial drug)
- **Optic neuropathy** (mild decreased vision, visual field defects)
- **Corneal keratopathy** which is pigmented deposits in the corneal epithelium.
- **Digitalis:** cardiac failure drug → causes ocular disturbances producing **chromatopsia** (**objects appear yellow**) with overdose.

- Mydriasis can be caused by:

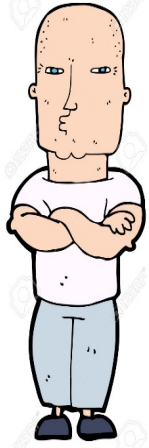
1. Adrenergic agonists (cause cycloplegia).

2. Muscarinic antagonist (which cause cycloplegia due to excess relaxing of Ciliary muscle like atropine).

- If alcohol is contaminated with methanol the person will lose his vision. Even when Methanol is drunken once it may cause blindness.



	Local anesthetics	Antibiotics
		<ul style="list-style-type: none"> • Penicillins, Cephalosporins, macrolides • Sulfonamides, Tetracyclines, chloramphenicol • Aminoglycosides, Fluoroquinolones, Vancomycin
Uses	<p>Topical: E.g. propacaine, tetracaine.</p> <ul style="list-style-type: none"> • Removal of corneal foreign bodies • Removal of sutures. • Examination of patients who cannot open eyes because of pain <p>Orbital infiltration: e.g. lidocaine, bupivacaine.</p> <ul style="list-style-type: none"> • Peri-bulbar or retro-bulbar • cause <u>anesthesia</u> and <u>akinesia</u> for intraocular surgery <p>Infiltration anesthetics mean injection</p>	<ul style="list-style-type: none"> ▪ Conjunctivitis (inflammation of conjunctiva) ▪ Keratitis (corneal inflammation) ▪ Blepharitis (eye lid inflammation) ▪ Endophthalmitis (intraocular tissue inflammation). ▪ Used topically in prophylaxis (pre and postoperatively) and treatment of ocular bacterial infections. ▪ Used orally for the treatment of preseptal cellulitis e.g. amoxicillin with clavulonate ▪ Used intravenously for the treatment of orbital cellulitis e.g. gentamicin, cephalosporin, vancomycin ▪ Can be injected intravitally for the treatment of endophthalmitis <p>1.Trachoma infectious disease caused by the bacterium <u>Chlamydia trachomatis</u> can be treated by topical and systemic tetracycline or erythromycin, or systemic azithromycin.</p> <p>2.Bacterial keratitis (bacterial corneal ulcers) can be treated by topical fortified penicillins, cephalosporins, aminoglycosides, vancomycin, or fluoroquinolones.</p> <p>3.Bacterial conjunctivitis is usually self limited but topical erythromycin, aminoglycosides, fluoroquinolones, or chloramphenicol can be used</p>

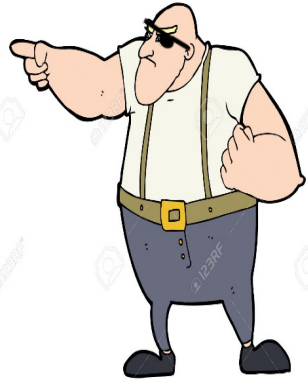
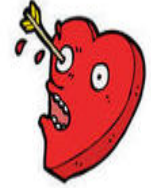


Propa-
carine



tetra-
carine

The **carine** family is well known for being a gang family their sons **prop** & **tetr** where known for being so tough that they can **take a forgin body out of their eyes !!!!**



lido-carine



bupiva-
carine

And they cousins **lido** & **bupiva** are way tougher that they lost one of their eyes after **injecting** themselves right **in the eye** !!!!!

Hadeel alsalmi

In a Spanish village called **prost** lived to buffalos **lateno & travo** people where glad-ins to see their bullfights, and they were so good that they beaten **beta Xs** matadors group.



Lateno-
prost



travo-
prost



Timo-
lol



carteo-
lol



betaxo-
lol

After **Beta Xs** matadors defeat they became **hypertensive** and the laugh of the city. People started adding **lol** to their names.

★ Summary

Drugs acting on parasympathetic system				Drugs acting on sympathetic system			
Cholinergic agonists		Cholinergic antagonists (Muscarinic antagonists)		Adrenergic agonists			
Direct agonists	Indirect acting agonists (anticholinesterases)	Natural alkaloids	Synthetic atropine substitutes	Non-selective agonists ($\alpha_1, \alpha_2, \beta_1, \beta_2$)	Selective α_1 agonists e.g. phenylephrine	Selective α_2 agonists e.g. apraclonidine (eye drops)	β blockers
Methacholine , carbachol , pilocarpine	Reversible: Physostigmine, neostigmine, demecarium Irreversible: ecothiophate, isoflurophate	Atropine 7-10 days Scopolamine (hyoscine) 3-7 days	Homatropine 1-3 days Cyclopentolate 24 hour Tropicamide 6 hour	e.g. epinephrine, Dipivefrin (pro-drug of epinephrine). Used locally as eye drops	Mydriasis (without cycloplegia), decongestant	Mechanism: ↓ production of aqueous humor, and ↑ uveoscleral outflow of aqueous humor	non-selective: timolol, carteolol Selective β_1 : betaxolol "cardioselective" Given topically as eye drops
USES: Glaucoma (open and closed angle) Counteract action of mydriatics To break Iris-lens adhesions in accommodative esotropia (ecothiophate) Induction of miosis in surgery Open angle glaucoma		USES: To prevent adhesion in uveitis & iritis Fundoscopic examination of the eye Measurement of refractive error		Uses: open angle glaucoma Mechanism: ↑ uveoscleral outflow of aqueous humor Side Effects: headache, arrhythmia, increased blood pressure	Uses: Fundoscopic examination of the eye To prevent adhesion in uveitis & iritis Decongestant in minor allergic hyperemia of eye.	Uses: open glaucoma treatment, prophylaxis against IOP spiking after glaucoma laser procedures.	Uses: open angle glaucoma Mechanism: Act on ciliary body to ↓ production of aqueous humor Advantages can be used in patients with hypertension
Contraindications of cholinergic agonists: Bronchial asthma , Peptic ulcers , Coronary vascular disease Incontinence Intestinal obstruction Systemic side effects of cholinergic agonists: Lacrimation, salivation, sweating, perspiration, bronchial constriction, urinary urgency, nausea, vomiting, and diarrhea. CNS effects: high doses (physostigmine & pilocarpine) Ocular side effects: diminished vision (myopia), headache, cataract, miotic cysts, and rarely retinal detachment		Contraindications of antimuscarinic drugs Glaucoma (angle closure glaucoma) Tachycardia, Prostate hypertrophy in old patients. Constipation, paralytic ileus.		C/I: In patients with narrow angles as they may precipitate closed angle glaucoma.	Side effects: May cause significant increase in blood pressure Rebound congestion precipitation of acute angle-closure glaucoma in patients with narrow angles.	Side Effects: headache, dry mouth, fatigue, Lethargy, bradycardia, and hypotension.	Side effects Bronchospasm (less with betaxolol) Cardiovascular (bradycardia, arrhythmia; hypotension, asystole, syncope) CNS effects (depression, weakness, fatigue). C/I in asthmatic patients or patients with CVS disorders.

★ Summary

Treatment of glaucoma				
Treatment of open angle glaucoma (chronic)		Treatment of narrow closed angle glaucoma (acute)		
<p>The main goal is to decrease IOP by:</p> <p>Decreasing production of aqueous humor</p> <p>Beta blockers</p> <p>Alpha-2 agonists</p> <p>Carbonic anhydrase inhibitors</p> <p>Increasing outflow of aqueous humor</p> <p>Prostaglandins</p> <p>Adrenergic agonists, nonspecific</p> <p>Parasympathomimetics</p> <p>Prostaglandins and Beta blockers are the most popular</p>		<p><u>Acute, painful</u> increases of pressure due to occlusion of the outflow drainage pathway</p> <p>emergency situation that require treatment before surgery</p> <p>(Iridectomy)</p> <p>The use of drugs is limited to :</p> <p>Oral Acetazolamide</p> <p>Topical cholinomimetics e.g.: pilocarpine</p> <p>Osmotic agents: hypertonic solution(Mannitol, Glycerol).</p> <p>Analgesics: pethidine or morphine (for pain)</p>		
<p>Carbonic anhydrase inhibitors</p> <p>e.g. acetazolamide (oral), dorzolamide (topical)</p>	<p>Prostaglandin analogues</p> <p>E.g. latanoprost, travoprost</p>	<p><u>Osmotic agents</u></p>	<p><u>Anti inflammatory:</u></p> <p>Corticosteroids</p>	<p><u>Anti inflammatory:</u></p> <p>NSAID</p>
<p>Mechanism: ↓ production of aqueous humor by blocking carbonic anhydrase enzyme required for production of bicarbonate ions (transported to posterior chamber, carrying osmotic water flow).</p>	<p>Mechanism: increase uveoscleral aqueous outflow.</p> <p>Latanoprost is preferred due to lesser adverse effects.</p> <p>they have replaced beta blockers.</p> <p>They are used topically as eye drops & <u>once a day</u>.</p>	<p>Mechanism: can rapidly lower IOP by decreasing vitreous volume.</p> <p><u>Glycerol 50% syrup</u>, orally (cause nausea, hyperglycemia).</p> <p><u>Mannitol 20% IV</u> (cause fluid overload and not used in heart failure).</p>	<p>Mechanism: inhibition of arachidonic acid release from phospholipids by inhibiting phospholipase A2</p>	<p>E.g. ketorolac, diclofenac</p> <p>Mechanism: inhibition of cyclo-oxygenase</p>

★ MCQs

1-Which of the following is not a characteristic of eye drops route of administration:

- a)The most common
- b)Has a long contact time
- c)It has to be used several times a day

2-Which of the following injections is best applied for a patient who was prescribed to acetylcholine for his cataract?

- a)Subconjunctival
- b)intravitreal
- c)intracameral

3-Which of the following statements is true regarding systemic administration:

- a)Lipid solubility of the drug is inversely proportional to the absorption.
- b)Protein binding is inversely proportional to the bioavailability of the drug.
- c)Protein binding is inversely proportional to the absorption.

4-A 45 year old asthmatic patient suffering of glaucoma the doctor has given him a drug to resolve all his symptoms –treat- . which of the following is the drug was prescribed for him:

- a)Physostigmine
- b)Apraclonidine
- c)Carteolol
- d)Dorzolamide

5-A 53 year old hypertensive female was referred to ophthalmic clinic as she had glaucoma. which of the following drugs works best for her :

- a)Selective $\alpha 2$ agonists
- b)Prostaglandins
- c) β blockers

6-which of the following is used in accommodative

- a)esotropia
- b)pilocarpine
- c)carbachol
- d)Isoflurophate

7-A 60 YO\M whose diabetic for the past 20 years has glaucoma –closed angle – .the doctor prescribed him a drug until he go into the surgery . which of the following is more suitable for him:

- a)Hydrocortisone
- b)Oral Acetazolamide
- c)Glycerol syrup

8-Which of the following is contraindicated for glaucoma

- a)Cyclopentolate
- b)Physostigmine
- c)Latanoprost

9-Which of the following Drugs causing corneal deposits:

- a)Chloroquine.
- b)Pilocarpine
- c)methanol.

- 1-b 5-c
- 2-c 6-c
- 3-c 7-b
- 4-d 8-a
- 9-a

Good luck!

Done by Pharmacology team 434

- **Maha Al-Rabiah**
- **Sarah Nasser Al-Jasser**
- **Mada albatli**
- **Mashaal Hussain**
- **Sarah Muhammad AlJasser**
- **Hadeel Alsulami**
- **Moneera Aldraihem**



For any correction, suggestion or any useful information do not
hesitate to contact us: Pharmacology434@gmail.com