

Study of the action of Drugs on Human Eyes

Lab-4

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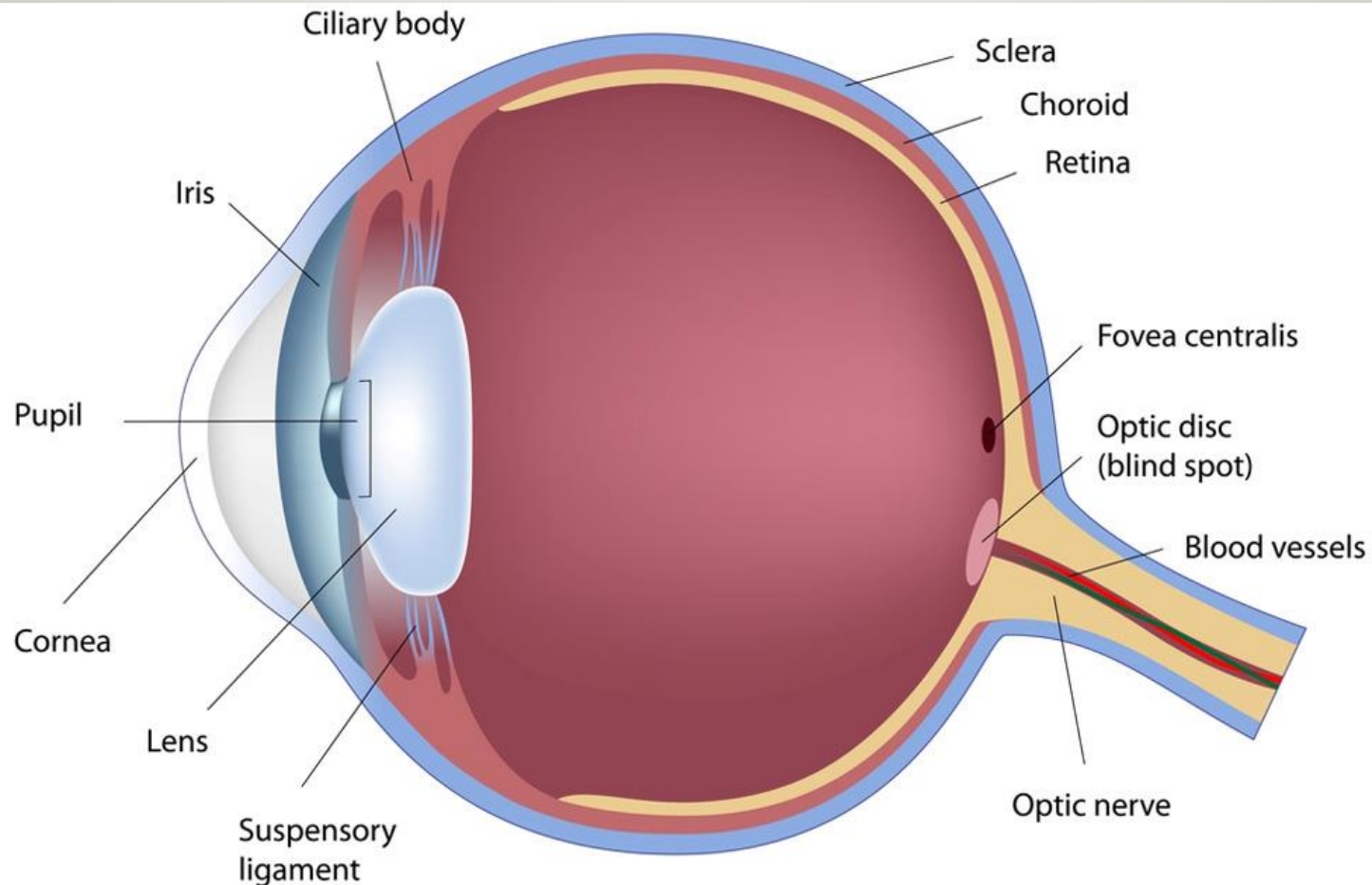
2019-2020

Eye

- is specialized sensory organ that mediate vision. The eye focuses images from external environment onto retina & convert them into electrical signals which then recognized by the brain.

Anatomy & Physiology of the Eye

The main compartments of the human eye are cornea, iris, lens, ciliary body and vitreous humour.

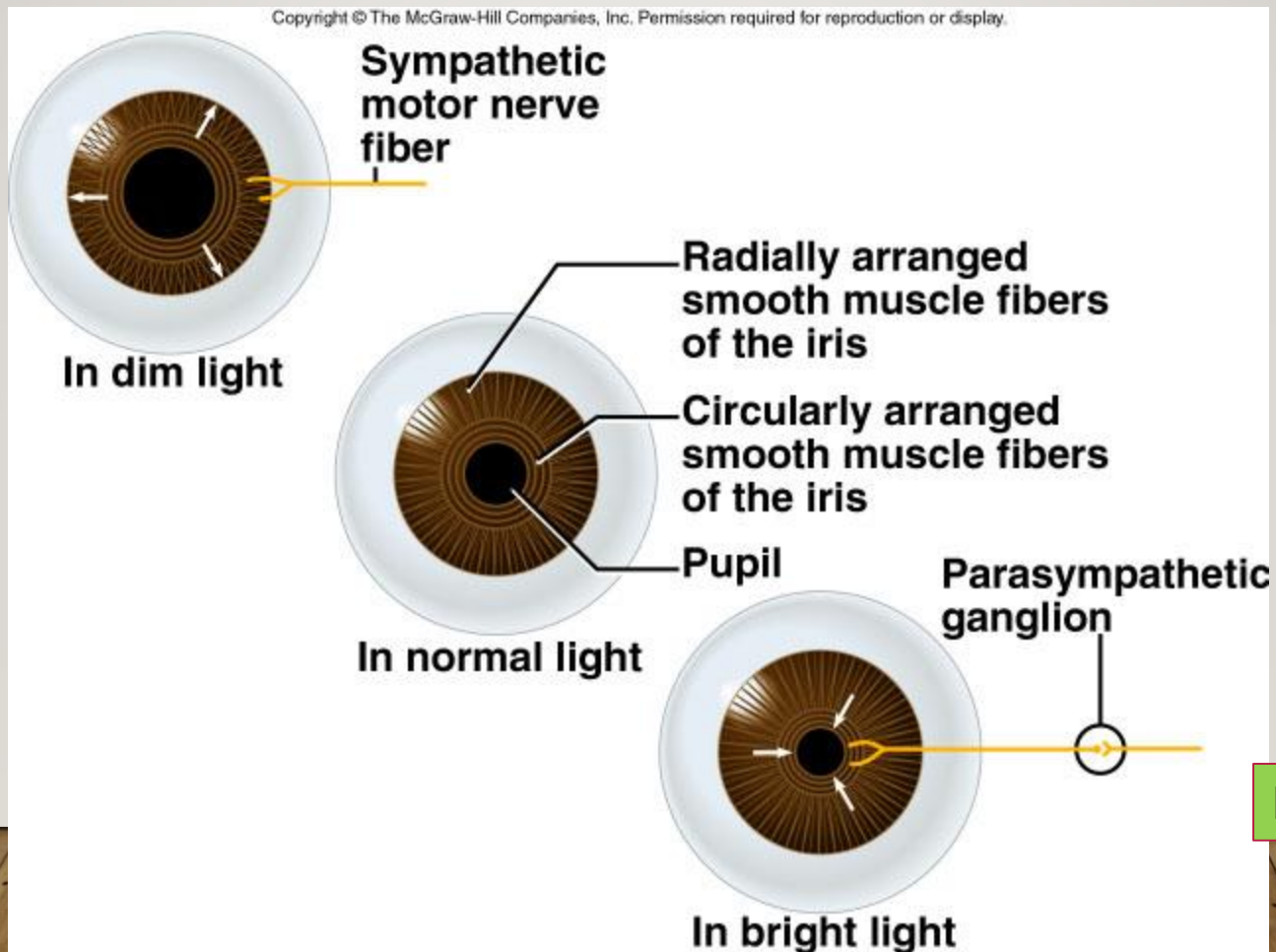


Pupil Diameter

- The **pupil** is the hole in the center of iris. The diameter of the pupil (pupil size) & hence the amount of light entering the eye is regulated by two anatomically innervated set of smooth muscles:
 - 1- **radial muscles** which innervated by adrenergic fibers (containing alpha I-receptors).
 - 2- **circular muscles** which innervated by cholinergic fibers (containing M3-receptors).
- **Notes: Miosis:** is due to either contraction of circular muscle or relaxation of radial muscle. **Mydriasis:** is due to either contraction of radial muscle or relaxation of circular muscle

HUMAN EYE ANATOMY

Regulation of the amount of the light



Mydriasis

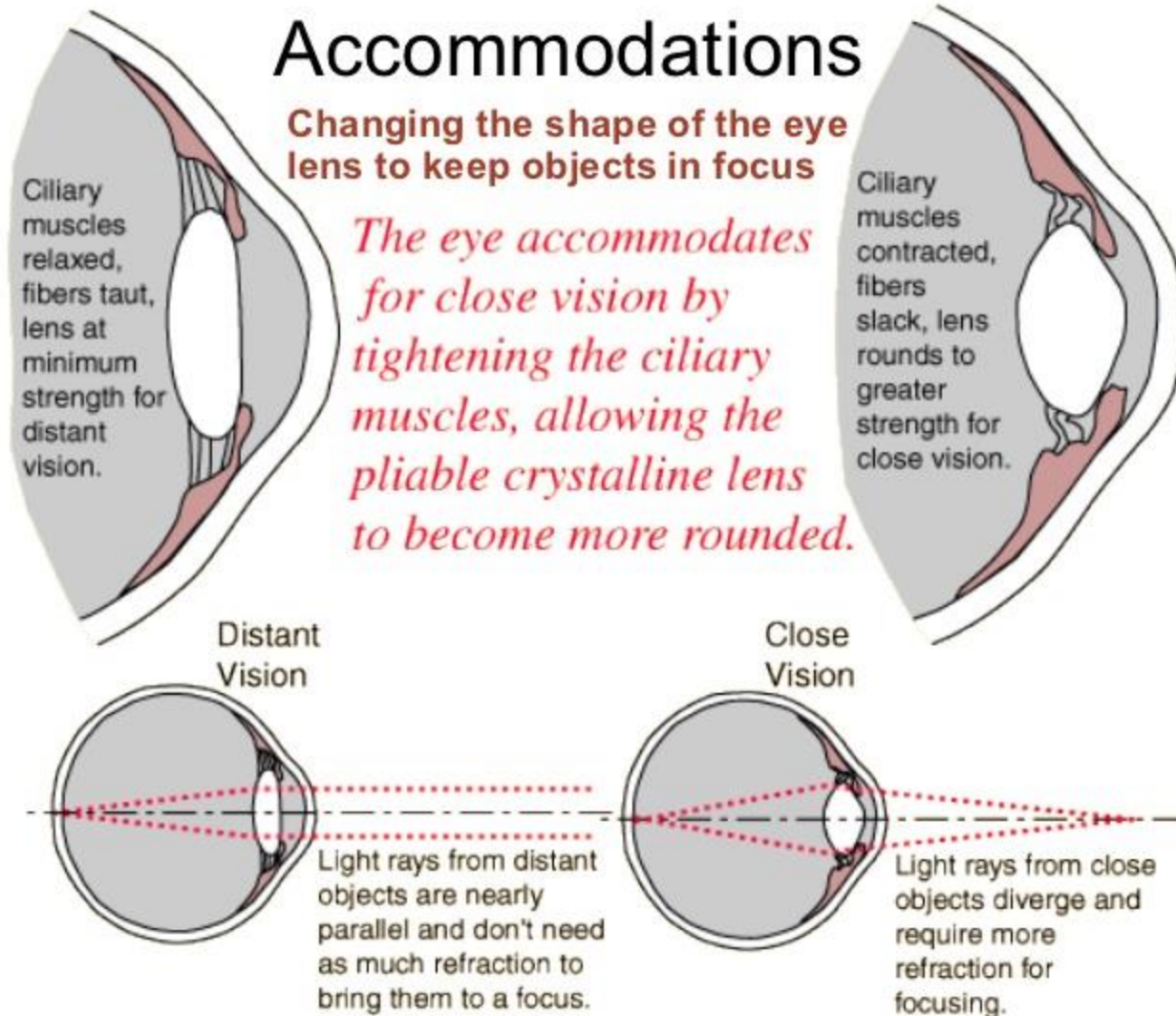
Miosis

Accommodation for Near & Far Vision

- Ciliary body involves ciliary muscle and ciliary epithelium
- Ciliary muscle (**M receptors**): responsible for near or far vision.
M-agonist → **Ciliary M. Contraction** → **Lens contraction** → **near vision**
Anti-Muscarinic → **Ciliary M. Relaxation** → **Lens relaxation** → **far vision**
- **Contraction** of ciliary muscle in response to **cholinergic** activation (M3 receptors) causes these suspensory ligaments to relax allowing the lens to become more convex & thus reducing its focusing to near objects only.
- **relaxation** of the ciliary muscle (e.g. by **antimuscarinic** agents) the suspensory ligaments will be stretch allowing the lens to become more flat so that the lens focused for distant objects.
- Drugs that antagonized accommodation for near vision termed **cycloplegics**, they are exclusively **muscarinic antagonists**. sympatholytic agents do not alter accommodation for near vision since there are no adrenergic receptors in the ciliary muscle.

HUMAN EYES ACCOMMODATION

Light
focusing



DRUGS AND HUMAN EYE

Topical administration

- Eye drops
 - Principally absorbed through the cornea
 - Short drug-eye contact time
- Eye ointments
 - Allow a prolonged contact time
- Eye lotions
 - Used for irrigation

Local injections and systemic treatment

- Physiological barriers limit systemically administered drug penetration to the eye
- Ex. acetazolamide for severely raised intraocular pressure

DRUGS AND HUMAN EYE

Ophthalmic anesthetics

- Ophthalmic anesthetics are agents that act locally to block pain signals at the nerve endings in the eyes
- Anaesthetic drops:
 - Initial assessment of minor trauma
 - Removal of conjunctival and corneal foreign bodies
 - In surgery
- Example:
 - Propracaine Hydrochloride 0.5% (Alcaine)
 - Tetracaine 0.5%
- Side effects:
 - Allergy: local or systemic



DRUGS AND HUMAN EYE

Dilating Drops (mydriatic medications)

- Mydriatics are used to enlarge the pupil for eye examinations
- Used in diagnosis and surgery
- **Parasympathetic antagonists (parasympatholytics)**
 - Paralyzing the iris sphincter muscle
 - Make the pupil larger and paralyze the muscle involved in focusing of the lens (accommodation)
 - Blurry eyes especially for up close (reading, near play)
 - Tropicamide: (Mydracyl) 0.5% and 1%. Action up to 6 hours
 - Cyclopentolate: (Cyclogyl) 0.5%, 1% and 2%. Action up to 24 hours
 - Homatropine: 2% and 5%. Action: 2-3 days.
 - Atropine: (Atropisol) Drops 0.5% or 1%, ointment 1%. Action: 1-2 weeks
- **Sympathetic agonists (sympathomimetics)**
 - Stimulate the iris dilator muscle.
 - Phenylephrine: 2.5% and 10%. Action 3-6 hours.

DRUGS AND HUMAN EYE

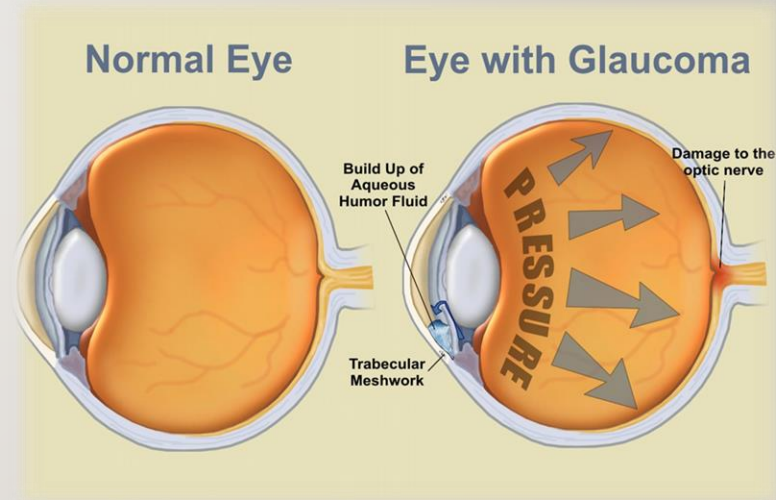
Miotic agents

- Dapiprazole (α_1 -antagonist)
- Pilocarpine (M_3 agonist)
- Isoproterenol, thromboxane A_2 , yohimbine, Tolazoline, prostaglandin growth factor 2α ($PGF_{2\alpha}$), inomysin, thapsigargin,.. etc.



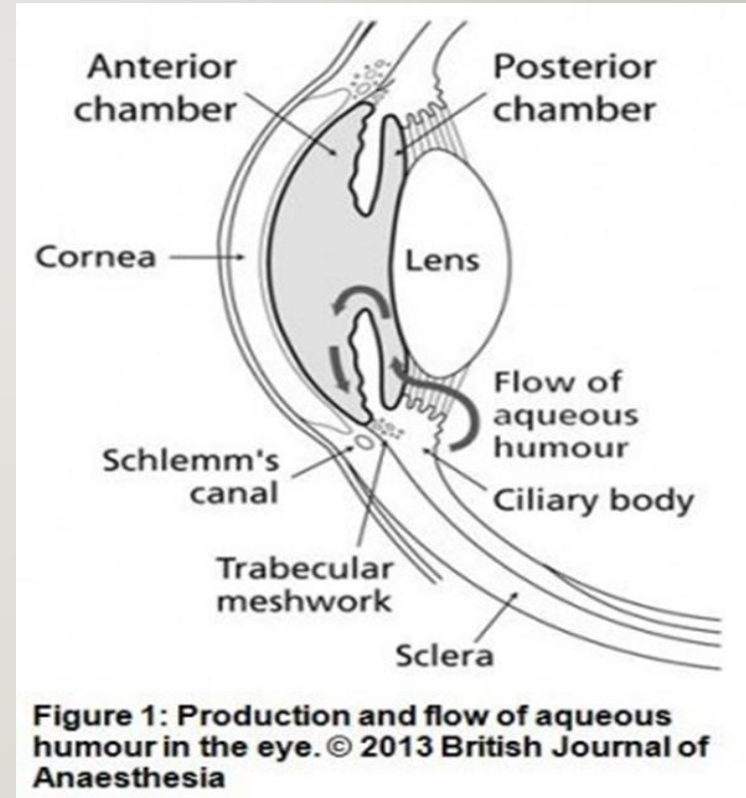
GLAUCOMA

- Disease of the eye in which fluid pressure within the eye rises
- May lead to vision loss
- Affects both eyes
- Symptoms :Loss of peripheral vision
Sensitivity to light and glare
Problems with night vision ,and Blurred vision
- Characterized chiefly by an increase in IOP above 21 mmHg & may be as high as 70 or 80 mmHg during the attack



Pathphysiology of Glaucoma

- The aqueous humor is a transparent, gelatinous fluid. It is secreted from the ciliary epithelium.
- In glaucoma, aqueous humor builds up and increases pressure within the eye
- Ciliary Epithelium (B2-Receptors) Responsible for secretion of aqueous humor.
- Ciliary muscle contraction → Increases flow → Decreases IOP.
- Ciliary muscle Relaxation → Decreases flow → Increases IOP (Glaucoma).



GLAUCOMA

Prostaglandins

- Treat open-angle glaucoma
- Prostanoid selective FP receptor agonist
- Increase the outflow of the aqueous humor
- Ex. latanoprost (Xalatan) and bimatoprost (Lumigan)

Beta blockers

- Reduce the production of intraocular pressure
- Blocks the action of the sympathetic nervous system, Causing reduction of intraocular pressure. The precise mechanism of this effect is not known
- Ex. timolol (Betimol, Timoptic) and betaxolol (Betoptic)

GLAUCOMA

Alpha-adrenergic agonists

- Reduce the production of aqueous humor and increase its outflow
- Ex. apraclonidine (Iopidine) and brimonidine (Alphagan)

Carbonic anhydrase inhibitors

- Systemic administration (oral)
- Carbonic anhydrase is an enzyme founded in the biochemical production of aqueous humor
- Reduce the production of aqueous humor
- Ex. dorzolamide (Trusopt) and brinzolamide (Azopt)

Miotic or cholinergic agents

- Increase the outflow of fluid within eyes
- Ex. pilocarpine (Isopto Carpine) and carbachol (Isopto Carbachol)



OBJECTIVES

At the end of the practical class the student shall be able to:

1. Instill drugs carefully into the volunteer eye by the pouch method without injuring the cornea.
2. Study the effects of drugs on the eyes

Methods

- Place one drop of the agents in the following table into on eye and check for the parameters mentioned in the following table:

Parameter	Pupil Size	Accommodation	Light Reflex	Blanching	Blinking	IOP
Agent						
Phenylphrine						
Pilocarpine						
Tropicamide						
lidocaine						
placebo						

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