Study of the action of Drugs on Human Eyes

Lab-3

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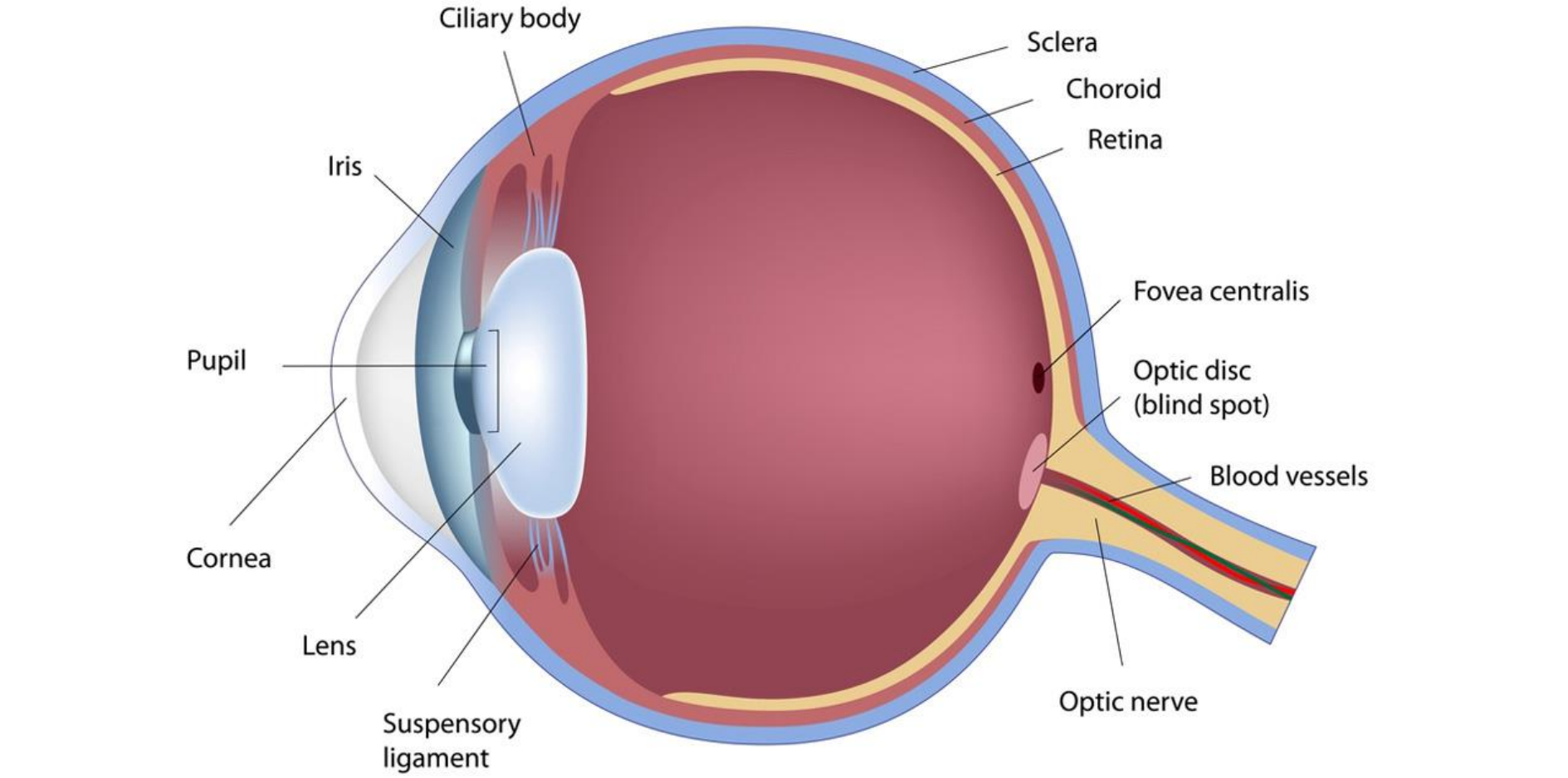
2021-2022

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 alpha1-receptors).

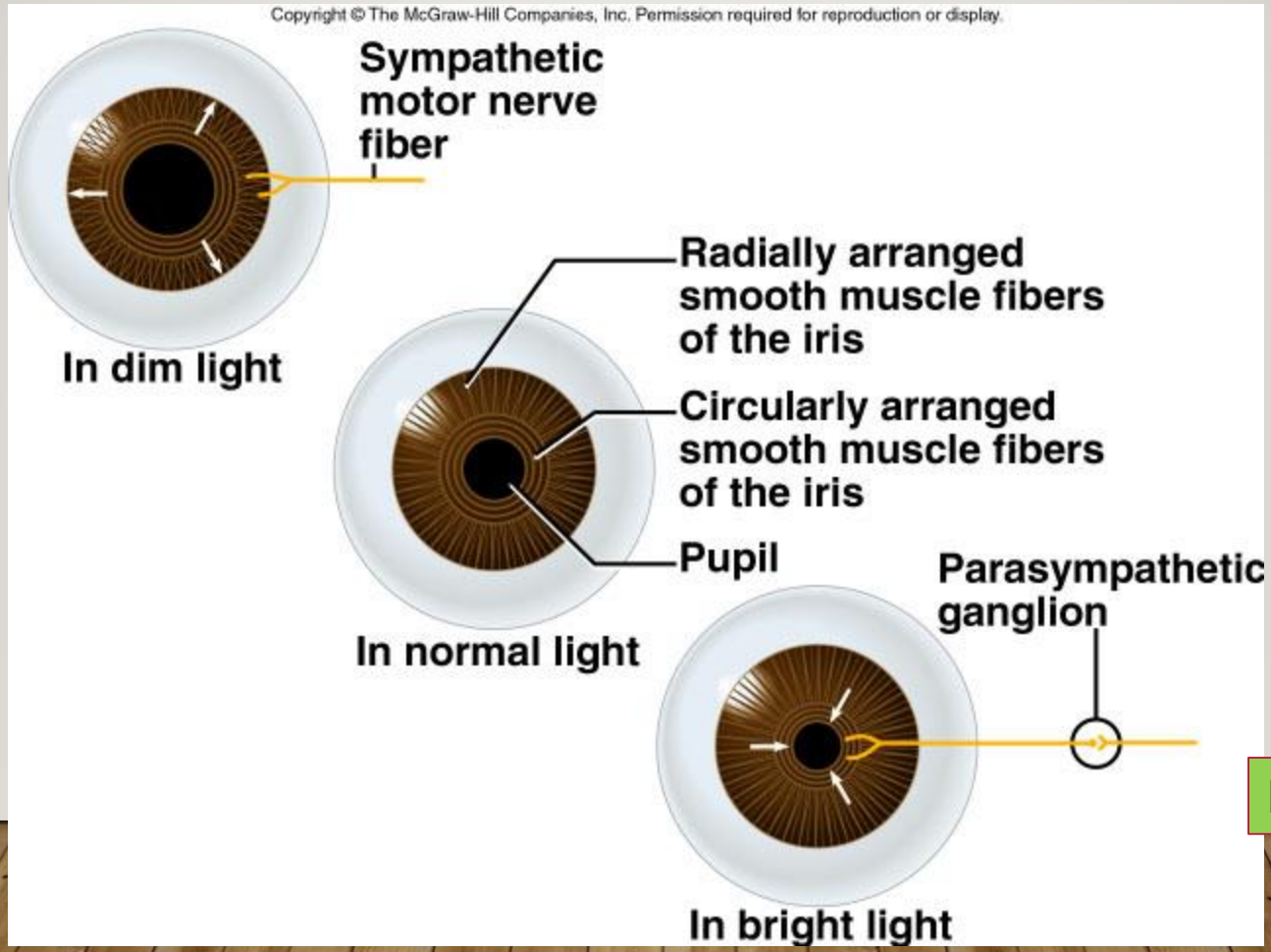
2- circular muscles which innervated by cholinergic fibers (containing M3-receptors).

- 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

Accummodation 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

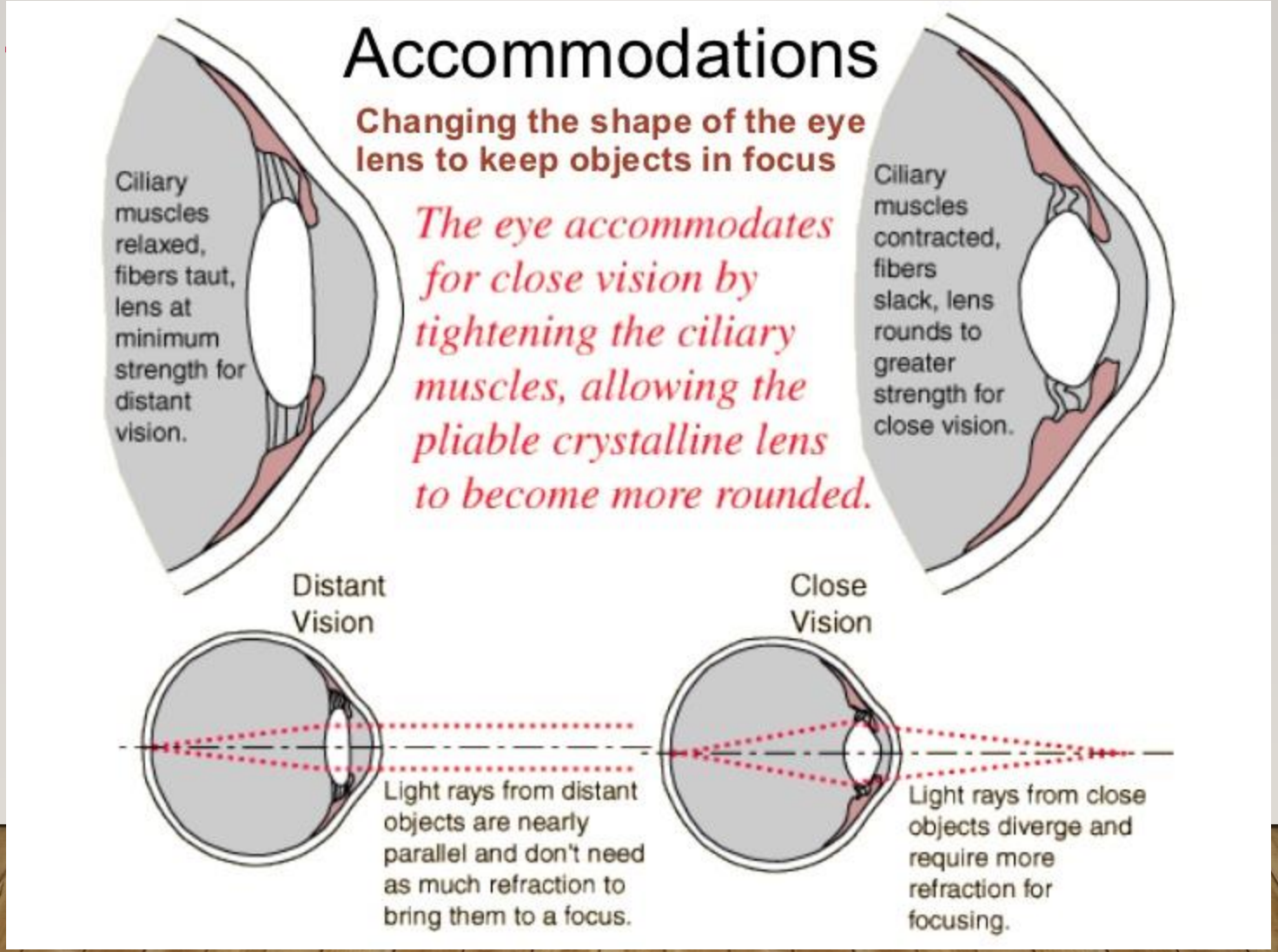
- Contraction of ciliary muscle in response to cholinergic activation (M3 receptors) causes these suspensory ligaments to relax allowing the lens to become more convex & thus reducing its focusing to near objects only.

- 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 accummodation for near vision termed cycloplegics, they are exclusively muscarinic antagonists. sympatholytic agents do not alter accummodation 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

Alcaine eye drop

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: (Mydriacyl) 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

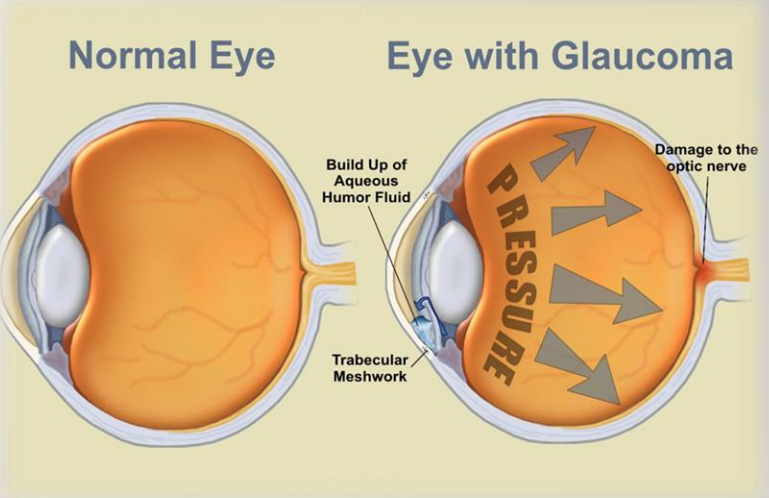
Miotic agents

- Dapiprazole (α1-antagonist)
- Pilocarpine (M3 agonist)
- Isoproterenol, thromboxane A2, yohimbine, Tolazoline, prostaglandin growth factor 2α (PGF2α), inomysin, thapsigargin,.. etc.

GLAUCOMA

- Disease of the eye in which fluid pressure within the eye rises
- May lead to vision lose
- Affects both eyes
- Symptoms :Loss of peripheral vision Sensitivity to light and glare

Problems with night vision ,and Blurred vision



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).

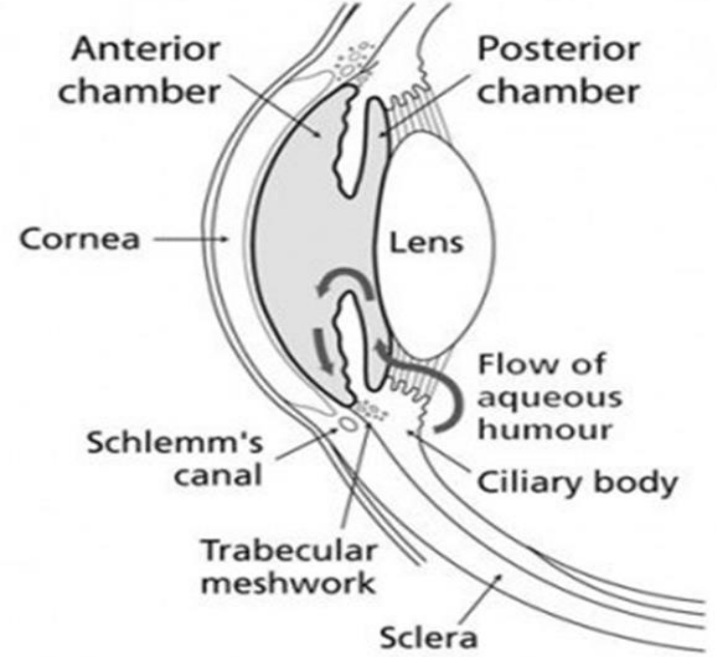


Figure 1: Production and flow of aqueous humour in the eye. © 2013 British Journal of Anaesthesia

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

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