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OCULAR PHARMACOLOGY
Overview

- drug classifications
- delivery methods
- Preparations: eye drops, ointments, injections
Eye drops

- most ocular medications are delivered topically - maximizes anterior segment concentrations and minimizes systemic toxicity

- drug gradient from tear reservoir to corneal and conjunctival epithelium forces passive absorption
Factors affecting absorption:

- drug concentration (limited by tonicity) and solubility (aqueous solution v’s suspension)

- viscosity (increased residence time)
Eye drops

- lipid solubility: lipid rich epithelial cell membrane v’s water rich stroma

- pH and ionic charge - most eye drops are weak bases existing in both charged and uncharged forms enhancing absorption
Eye drops

- Surfactants - preservatives used are surface-active agents that alter cell membranes in the cornea as well as bacteria, increasing drug permeability and preventing bacterial contamination
Eye drops

- Reflex tearing: ocular irritation and secondary tearing wash out of the drug reservoir in the tears and reduce contact time with cornea. This occurs when drops are not isotonic, have non-physiological pH or contain irritants.
Eye ointments

- increases contact time of drug with ocular surface
- mixture of petrolatum and mineral oil
- water-soluble drugs are insolvent in the ointment and are present as microcrystals. The surface microcrystals dissolve in the tears, the rest are trapped until the ointment melts
Eye ointments

- only drugs with high lipid solubility and some water solubility will get into both tears and corneal epithelium eg. chloramphenicol and tetracycline both achieve higher aqueous levels as ointment rather than drops
Peri-ocular injections

- subconjunctival, subTenon’s and retrobulbar
- allow drugs to bypass the conjunctival/corneal epithelial barrier and reach therapeutic levels in the posterior segment
- e.g., anaesthetic agents, steroids, botulinum toxin
Intraocular injections

- allow instant drug delivery at therapeutic concentrations to target site
- intracameral eg. antibiotics, viscoelastics, miochol
- intravitreal eg. triamcinolone, avastin
drug getting into eye from systemic circulation limited by tight junctions in vascular endothelium of retinal vessels, and non-pigmented epithelium of ciliary body

drugs with higher lipid solubility pass through blood-ocular barrier more readily
- extent of drug bound to plasma proteins also effects access of drug into eye - only unbound form can pass blood-ocular barrier
  - bolus administration exceeds the capacity of a drug to bind to plasma proteins and so leads to higher intraocular drug levels than with slow IV drip
Sustained release devices

- Devices available for steroid, gancyclovir delivery within vitreous cavity
CLASSIFICATION

USES:

- THERAPEUTIC
- DIAGNOSTIC
CLASSIFICATION

ROUTE
- TOPICAL
- SUBCONJUNCTIVAL
- SUBTENON
- INTRAVITREAL
- INTRALESIONAL
- SYSTEMIC
THERAPEUTIC

- ANTIBIOTICS
- ANTIVIRAL
- ANTIFUNGAL
- ANTI-INFLAMMATORIOUS
  - STEROIDS
  - NSAIDS
- ANTIALLERGICS
- ANTIPARASITIC
- ANTIGLAUCOMA
- MYDRIATICS, CYCLOPLEGICS
- ARTIFICIAL TEARS
- ANTIOXIDANTS (Lutein, xanthin, copper, zinc, beta carotene)
- ANTI-VEGF
- ANTIMETABOLITES
- RIBOFLAVIN
- BOTULINUM TOXIN (BOTOX)
DIAGNOSTIC

- PROPARACAINE
- FLOURESCIENCE
- ROSE BENGAL
Route:
Topical
- CIPROFLOXACIN 0.3%
- MOXIFLOXACIN 0.5%
- TOBRAMYCIN 0.3%
MOA: act on DNA/RNA of bacteria

Periocular
- Ceftazidime
- Vancomycin
- Cefuroxime
ANTIBIOTICS

Routes:

Intravitreal
- Ceftazidime
- Vancomycin
- Amikacin

Systemic
- Penicillins
- Cephalosporins
- Fluoroquinolones

MOA: cell wall inhibitors
ANTIBIOTICS

Uses:
- Bacterial Conjunctivitis
- Bacterial Corneal Ulcers
- Endophthalmitis
- Bacterial Uveitis (Syphylitic, Tuberculous)
- Bacterial Blephritis, Internal Hordeolum, External Hordeolum
- Dacryocystitis
ANTIVIRALS

Route:
Topical
- Acyclovir (ointment)

Intravitreal

Systemic:
- Acyclovir
- Ganciclovir
- Famciclovir
- Foscarnet
- HAART (Highly active antiretroviral therapy)
ANTIVIRALS

Uses:
- Herpes Simplex Keratitis
- Herpes Zoster Ophthalmicus
- Epithelial Keratitis
- Disciform Keratitis
- Necrotizing Stromal Keratitis
- Viral Posterior Uveitis (CMV, HZV, HIV; Necrotizing Retinitis, Vitritis, Choroiditis)
- Viral Conjunctivitis
ANTIFUNGAL

**Route:**

**Topical:**
- Natamycin 5%
- Amphotericin B 0.15%
- Econazole 1%

**Systemic:**
- Voriconazole
- Itraconazole
- Fluconazole
Uses:
- Fungal Keratitis (Ulcer)
- Fungal Endophthalmitis
- Fungal Retinitis & Choroiditis
ANTI-INFLAMMATORY

STEROIDS:
MOA: get translocated into nucleus, increase anti inflammatory transcription of genes.

Route:
Topical:
- Dexamethasone
- Predisolone
- Fluorometholone

Periocular (Subconjunctival, Subtenon)
- Triamcinolone
- Dexamethasone
- Methylprednisolone
ANTI-INFLAMMATORY

STEROIDS

PRED FORTE®
(Prednisolone acetate)

OPHTHALMIC SUSPENSION

STERILE 5 ml 1.0%
ANTI-INFLAMMATORY

STEROIDS:
Route:
Intravitreal:
- Triamcinolone
- Dexamethasone

Intralesional:
- Triamcinolone
ANTI-INFLAMMATORY

- Subtenon Injection
Steroids:

Uses:
- Mooren’s Ulcer
- Conjunctivitis (Bacterial, Viral, Allergic, VKC)
- Blephritis
- Uveitis
- Endophthalmitis
- Panophthalmitis
- Idiopathic Orbital Inflammatory Disease
Steroids:

Uses:

- Optic Neuritis
- Chalazion
- Scleritis
- Episcleritis
ANTI-INFLAMMATORY

STEROIDS:
Route:
Systemic:
- Tab. Prednisolone
- Inj. Dexamethasone
- Inj. Methylprednisolone
NSAIDs:
Route:
Topical:
- Diclofenac Sodium
- Flurbiprofen
- Nepafenac
Systemic:
- Diclofenac
ANTI-INFLAMMATORY

Uses:
- Keratitis
- Conjunctivitis
- Uveitis
- Scleritis
- Episcleritis
- Dacryocystitis
ANTI-ALLERGICS

Routes:
Topical:
Antihistamines & Mast Cells Stabilizers
- Olopatadine
- Sodium Cromoglycate
- Ketotifen
- Tetrahydrozoline
Uses:
- Allergic Conjunctivitis
- VKC
- Atopic Conjunctivitis
Routes:
Topical
- Polyhexamethylene biguanide 0.2%
- Chlorhexidine Digluconate 0.02%
- Propamidine

Oral:
- Albendazole
- Ivermectin
- Uses:
  - Acanthamoeba Keratitis
  - Parasitic Uveitis
  - Parasitic Endophthalmitis
BETA BLOCKERS:
Mechanism of Action:
- Decrease IOP by decreasing aqueous secretion

Side Effects:
- Allergy, Bradycardia, hypotension, bronchoconstriction

Contraindication:
- Asthma, COPD, heart blocks, CCF
BETA BLOCKERS:
- Timolol
- Betaxalol (Betoptic-S)
- Levobunolol (Betagan)
ALPHA-2 AGONISTS:

Mechanism of Action:
Decreased Aqueous production and increased uveoscleral Outflow

Preparations:
Brimonidinide (Alphagan 0.2%)
Apraclonidinide (Iopidine 1%) after Laser
PROSTAGLANDIN ANALOGUES:
Mechanism of Action:
- Act on prostaglandin receptor located in different ocular tissues and so regulate IOP and blood flow
PROSTAGLANDIN ANALOGUES:
Preparations:
- Latanoprost 0.005%, Travoprost 0.004% (F2 Alpha Analogues)
- Bimatoprost 0.03%
- Tefluprost 0.0015%
Side Effects:

- Eyelash thickening, lengthening, hyperpigmentation, and Iris and periobital skin hyperpigmentation
- Cystoid Macular Oedema
CARBONIC ANHYDRASE INHIBITORS:

**MOA:** Dec IOP by dec secretion of aqueous

**Topical:**
- Dorzolamide
- Brinzolamide

**Systemic:**
- Acetazolamide
MIOTICS:
- Pilocarpine 0.5%, 1%, 2%, 4%
- Carbachol 3%

MOA:
- In POAG ➔ contraction of ciliary muscles ➔ increase trabecular outflow
- In PACG ➔ sphincter pupillae contraction ➔ miosis ➔ pulls iris away from trabeculum
Combined Preparations:

- Cosopt (Timolol, Dorzolamide)
- Xalacomb (Timolol, Latanoprost)
- Timpilo (Timolol, Pilocarpine)
- Combigan (Timolol, Brimonidine)
- Duotrav (Timolol, Travoprost)
SYSTEMIC CARBONIC ANHYDRASE INHIBITORS:

- Acetazolamide
- Diclorphenamidine
- Methazolamide
Side Effects:
- Paresthesias
- Malaise complex
- GI Disturbances
- Renal Stone formation
- Blood Dyscrasias
- Hypokalemia
- Stevens Johnson Syndrome
OSMOTIC AGENTS:
- Mannitol (1g/kg body wt, IV)
- Glycerol (2ml/kg body wt, orally)
- Isosorbide (2ml/kg body wt, orally)

Uses:
- When a temporary drop in IOP is required, (Acute angle closure, before intraocular surgery with raised IOP)
MANNITOL

500 mL

Sterile, Non-pyrogenic, Single-dose Container

Formulation:
- Sodium Mannitol 250 mg/mL
- Distilled water

Indications:
- Hypertonic Therapy
- Treatment of Intracranial Complications

Storage:
- Store at room temperature not exceeding 30°C

Please refer to the product label for complete instructions and precautions.

Manufacturer:
- [Manufacturer Name]
MYDRIATICS & CYCLOPLEGICS

Topical
- Cyclopentolate 1%
- Tropicamide 1%
- Atropine 1%

Subconjunctival (Mydricaine)
- Atropine, Adrenaline, Lignocaine
MOA:
- to prevent posterior synechie formation,
- To break PS
- To relieve the sphincter spasm

Uses:
- Uveitis
- Corneal Ulcer
ANTIOXIDANTS

- Lutein, xanthin, copper, zinc, beta carotene

Uses:

- Retinal diseases e.g. Age-related Macular degeneration, Retinitis Pigmentosa and other hereditary fundus dystrophies
ANTI-VEGF

- Avastin, Bevacizumab
- Intravitreal
- Proliferative Retinopathies due to ischemic Retina (PDR, NVG, Post CRVO)
**RIBOFLAVIN DROPS:**
- Used in keratoplasty treatment CXL (corneal cross-linkages)

**BOTULINUM TOXIN (BOTOX):**
- Hemifacial Spams
- Squint
- Cosmetic
- **Artificial tears:**
  - Dry eye, corneal ulcers
  - Drops. Gels
  - Hyperomellose, viscotears, polyvinyl alcohol.
  - Acetylcysteine
- **Antimetabolites**
  - 5-fluorouracil, mitomycin c
  - Glaucoma surgery (trab), pterygium excision.
  - MOA: inhibit DNA synthesis and replication.
DIAGNOSTIC

- PROPARACAINE
- FLOURESCIENCE
- ROSE BENGAL
Fundus Fluorescein Angiography

- Diabetic Retinopathy
- Macular Oedema
- Macular Hole
- AMD
FLUORESCEIN AND ROSE BENGAL STRIPS

- Corneal Ulcers
- Filamentary Keratitis (Dry Eye)
Proparacaine

- Local anesthetic
- To remove foreign bodies
- Suture Removal
MYDRIATICS & CYCLOPLEGICS

Topical
- Cyclopentolate 1%
- Tropicamide 1%
- Atropine 1%

Uses:
- Fundoscopy
- Cycloplegic Refraction in Children
- Squint
Any Questions??
THANKYOU