

Pediatric Pharmapalooza

Nidhi Rana MS, OD, FAAO

Wills Eye Hospital/ University Children Eye center



-
- No financial disclosure
 - Email: drnidhirana@yahoo.com
 - Cell: 856-981-0778



Systemic Medications

- Worldwide prevalence Adverse Drug Reactions
 - 5-7%
- Serious ADR
 - Up to 17% in hospitalized children
- Pediatric ADR
 - Neonates are at higher risk and 58% of their ADR are serious
 - At least 1/3 avoidable

Pediatric Prescribing

- 1/5 children prescribed at least one drug per outpatient visit
- 7.5% prescribed 2 or more drugs per visit
- Off label use common
 - 50% of drugs in US not approved for children
 - Europe 2-13 % of pediatric outpatient visits use off label drugs

Pediatric Prescribing

- Altered pharmacokinetics (immature)
 - Absorptive surface maturation (gut, skin)
 - Gastric PH is higher in kids
 - Emptying times lower in kids
 - Renal function only mature until age 1-2 yrs old
 - Liver metabolism matures over several years
 - Body water decreases and fat increases with age
 - Lower plasma concentrations of hydrophilic drugs

Prescribing Essentials

- History taking
 - Chief complaint
 - Red eyes for how long?
 - Associated symptoms – discharge (which color)
 - Associated with decrease VA
 - Trauma
 - Birth history
 - Full term born/ premature
 - Birth weight
 - Normal / C section
 - Family history
 - Glasses/ amblyopia/ strabismus



Prescribing Essentials

- Medications
- Allergies to medication/ food/ seasonal
- Pt Medical history
 - Heart issues / asthma (1 in 12/ 6 million kids)
 - GI issues/ ulcers /liver function
 - Kidneys function
 - G6PD – sulfa, favisim (400 million)
 - h/o Seizures
 - Eczema/ atopy (20%)
- Present weight of the child – lbs /kgs
 - 1kg = 2.2lbs

Prescribing Essentials

- Right drug
- Right route of administration
 - Topical/ oral/ IV/ IM
- Right dose
- Right duration of time
- Ointment vs drops
- Brand name vs generic
- Self preserved or preservative
- Acute disease/ chronic disease



Prescribing Essentials

- Children > 12 yo and older can be dosed as adults/
 >100 lbs
- Weight is always important in prescribing – not the age of the child
- Dosage of child
 - Given in mg/kg/day

Clinical pearl

- Consult with the pediatrician before giving them oral medication
- Work together
 - Bottom line: is to do what's best for your patient

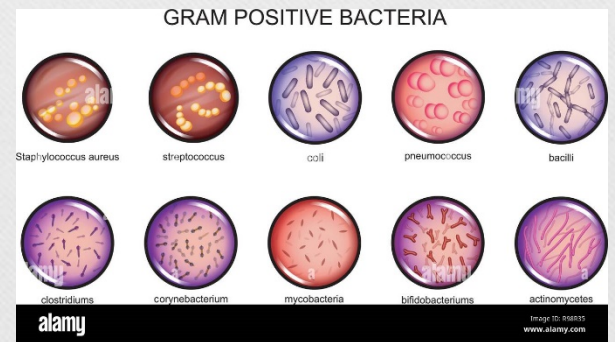
Medications

- Antibiotics
- Antivirals
- Glaucoma
- Allergy medications
- Steroids
- Dilating agents
- Systemic medications



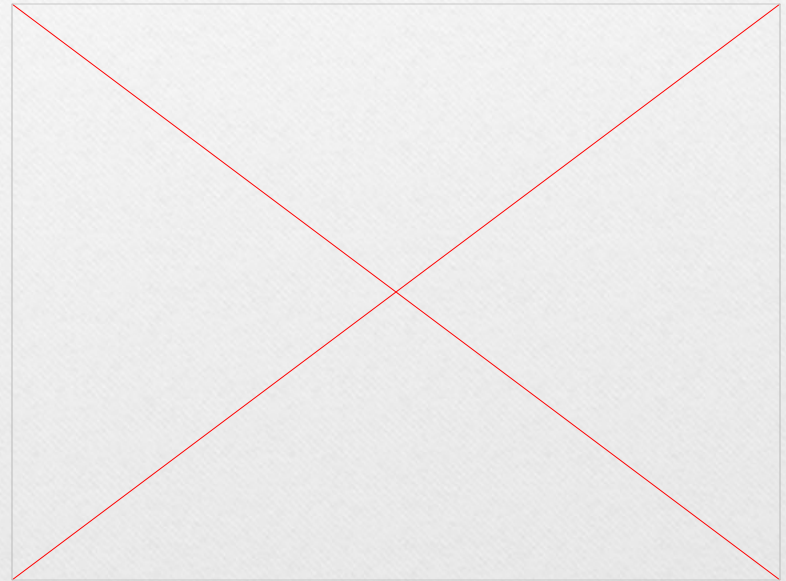
Pathogens

- Bacteria
 - **Gram positive**
 - Staphylococcal aureus – conjunctivitis/ preseptal cellulitis
 - Epidermidis
 - Streptococcus pneumoniae – conjunctivitis / orbital cellulitis
 - **Gram negative**
 - Haemophilus influenzae – orbital cellulitis
 - Serratia
 - Pseudomonas
 - Moraxella



Pathogens

- MRSA/ MRSE
- Fungus
- Viral
- Anaerobes – bug bites (cellulitis)



Case 1

- 5mth old F
 - Crusting of lashes for 1 week now OD
 - Some redness in OD
 - Some puffiness of eyelid
 - Watery discharge
- F/T born, weighed 6lbs 10oz at birth, normal delivery
- Meds: none, NKDA
- Gen health: good

Case 1

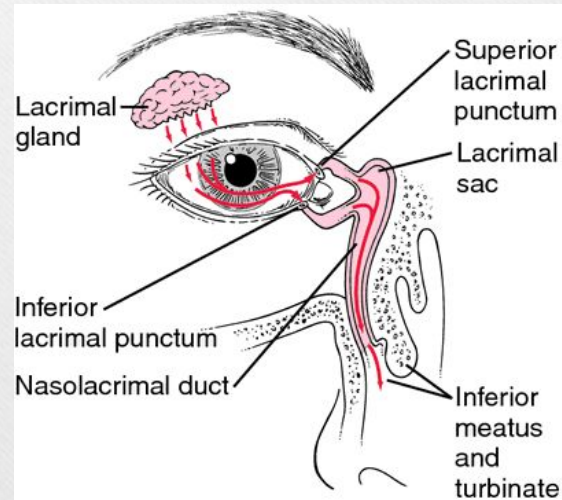
- Anterior Segment:



- [Nasolacrimal Duct Obstruction in Children - American Academy of Ophthalmology \(aao.org\)](http://www.aao.org)
- Cycloplegic Refraction:
 - +2.50sph OU
- Fundus:
 - Unremarkable with healthy nerves and macula OU

Case 1

- Diagnosis
 - Nasolacrimal Duct obstruction OD



The lacrimal apparatus. From Jarvis, 1996.

Antibiotics

- **Bactericidal** – directly kill the bacteria
 - Aminoglycosides
 - Fluroquinolones
 - Penicillins
 - Cephalosporins
- **Bacteriostatic** – stop bacteria from growing
 - Sodium sulfacetamide – sulfa drugs
 - Trimethoprim
 - Some degree erythromycin
 - Tetracycline

Antibiotics

- Narrow spectrum
 - Work on narrow range of bacteria
- Broad spectrum
 - Work on wide range of bacteria

Nasolacrimal Duct obstruction

- Dacryostenosis
- Canalization of the NLD system is complete by 8th mth of gestation
- Upto 20% of newborns
- Cause: duct fails to canalize, persistent layer of lacrimal or nasal epithelial cells fails to open the valve of hasner
- 90% resolve by 12-14mth of age
- Treat accompanying symptoms

Case 1



- Treatment options:
 - Clean the eye and watch
 - Remember 90% will resolve
 - Hydrostatic massages
 - Topically:
 - Polytrim eyedrops tid OD for 3-5 days
 - Bacitracin ung tid OD for 3-5 days
 - Probing considerations

Topical antibiotics

- Treatment choices
 - **Bacitracin**
 - Gram +ve bactericidal drug
 - Destruction of bacterial cell wall
 - Ointment only
 - Generically available
 - **Bacitracin with Polymyxin B (Polysporin)** – any age
 - Gram +ve and Gram -ve bactericidal drug
 - Destruction of the bacterial cell membrane
 - Ointment only
 - Generic available



Topical Antibiotics

- **Bacitracin, Polymyxin B and neomycin (neosporin)**
 - Neomycin inhibits protein synthesis
 - Broad spectrum except on pseudomonas
 - That's why combination with polymyxin B
 - Ointment and eyedrop
 - Cause type IV delayed hypersensitivity reaction (5-10%)
- **Trimethoprim and polymyxin B (Polytrim) \geq 2mths**
 - Broad spectrum bacteriostatic/bacteriocidal antibiotic
 - Inhibits bacterial folic acid synthesis
 - Streptococcus pneumoniae and haemophilus influenzae
 - Eye drop
 - Generic available

Topical Antibiotics

- **Erythromycin**

- Bacteriostatic against gram +ve and Gram -ve
- Interruption of protein synthesis
- Resistance has developed – oral
- Newborns for newborn conjunctivitis

- **Azithromycin (Azasite) >1yo**

- Macrolide
- Inhibition of protein synthesis
- Prolonged intracellular half life – dosed less frequently
- Ex: One gtt bid for first two days and once for 5 more days
- Expensive \$\$\$



Topical Antibiotics

- **Aminoglycosides**

- Gentamycin/Tobramycin/Neomycin
- Not used systemically – ototoxicity
- Inhibitor of bacterial protein synthesis
- Gentamycin – not used for epithelial toxicity
- **Tobramycin** >2mths old– less epitheliotoxic response
- Gram –ve spectrum
- Concentration dependent in their bactericidal properties
- Dosed more frequently and longer time 7- 10 days



Topical Antibiotics

- **Fluoroquinolones**

- Ciprofloxacin (ciloxan)- 0.3% \geq 1yo
 - Wide range antibacterial activity
- Ofloxacin (ocuflox)- 0.3% \geq 1yo
- Gatifloxacin (zymar)- 0.3% \geq 1yo
 - 4th generation better against gram +ve
- Levofloxacin (quixin)-0.5% \geq 1yo, 1.5% (Iquix) PF \geq 6yo
- Moxifloxacin (vigamox)-0.5% PF \geq 1yo
 - 4th generation better against gram +ve
- Besifloxacin hydrochloride (Besivance) $>$ 1yo
- Not as effective against MRSA
- Better penetration into ocular tissue



Case 2

- 4yo Female
 - Swelling of eyelid for past 2 days getting worse
 - No fever
 - Some pain
 - Greenish/yellowish d/c
 - Vision is good
- Meds: none, NKDA
- No trauma

Case 2

- F/T born, weighed 5lbs at birth, normal delivery
- Family history: unremarkable

Case 2

- VA sc: 20/20 OS: 20/20
- EOM: full OU
- Pupils: PERLA, No APD
- Some tenderness on touch
- Chalazion for few weeks now

Case 2



- Anterior segment
- Retinoscopy: +0.50sph OU
- Dilated exam: unremarkable, healthy nerves and macula OU

Case 2



- Diagnosis
 - Preseptal cellulitis
- Treatment for chalazion
 - Induced astigmatism
 - Risk for amblyopia
 - Lid hygiene/ massages
- Treatment for preseptal
 - Topically: polytrim tid/ tobradex
 - Oral: Augmentin/ Clindamycin
 - Both



Oral Antibiotics

- **Penicillin**
 - **Amoxicillin**
 - Synthetic penicillin
 - **Amoxicillin with clavulanate (Augmentin)**
 - Gram +ve and gram -ve, covers anaerobes – insect bites
 - Partially metabolized by liver and excreted by urine
 - Side effects: diarrhea, cramps
- **People with penicillin allergy**
 - Macrolide, fluoroquinolone, ?? Cephalosporin
 - Clindamycin – MRSA
 - Sulfa – Bactrim



Example



- 40lbs 5yo preseptal cellulitis
- 1kg = 2.2lbs
- 40lbs = 18kgs
- 20- 40mg/kg/day in divided doses q 8-12 hrs
- 125mg and 250mg/5ml suspensions
 - Dose q8hr
- 200 and 400mg/5ml suspensions
 - Dose q 12hrs

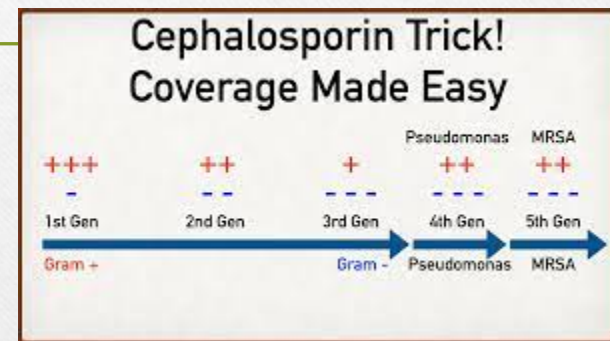
Example

- 40lbs = 18kgs
- $18 \times 40\text{mg/kg/day} = 727 \text{ mgs/day}$
 - 727 divided by 2 = 363 mgs q 12 hrs
 - 727 divided 3 = 242mg q8hrs
- Round to 250 mgs q 8 hrs
- Prescribe 250mg/5ml
- Give 5ml or 1tsp q 8hrs for 7-10 days

Oral Antibiotics

- **Cephalosporins**

- Closely related to penicillins
- 5-10% allergenicity with penicillins
- Inhibits cell wall synthesis
- Decreasing gram +ve coverage with increasing gram -ve coverage with each higher generation
- 3 generations
- Keflex (cephalexin) – 1st generation
 - Good gram +ve coverage (staph/ strep)
 - 20- 40mg/kg/day divided q8hr
- Omnicef – 3rd generation



Oral Antibiotics

- **Macrolides**

- Inhibits bacterial protein synthesis
- Erythromycin
 - 30-50mg/kg/day divided q6hrs (max 4 gms /day)
- Clarithromycin
- Azithromycin
 - Less GI effects than erythromycin
- Chlamydicidal



Oral Antibiotics

- **Fluoroquinolones**

- \$\$\$
- Levaquin or levofloxacin
 - Usually used for UTI infections
- Not really used in children < 16yo
 - May decrease cartilage and bone formation



- **Sulfa medications**

- Bactrim (sulfamethoxazole and trimethoprim)
 - Avoid in patients with G6PD, liver or kidney disease, anemia patients

Oral Antibiotics

- **Tetracycline**

- Stops bacterial protein synthesis
- Not in pregnancy
- Not in children < 12yo
 - Linked to pseudotumor cerebri / tinnitus
 - Photosensitivity in children
 - Yellowish staining of the teeth
- In adults good for tx of blepharitis and acne rosacea



[Papilledema - EyeWiki \(200.000\)](#)



Case 3



- 4yo F swelling getting worse, eyelid completely shut
 - Pain
 - Fever and lethargy
- EOM: not full range of motion
- VA sc: 20/25 OS: 20/40

Case 3



- Diagnosis
 - Orbital cellulitis OS
- Treatment:
- Send them to ER
- IV antibiotics
 - Sent home with oral antibiotics
- CT scan/ MRI

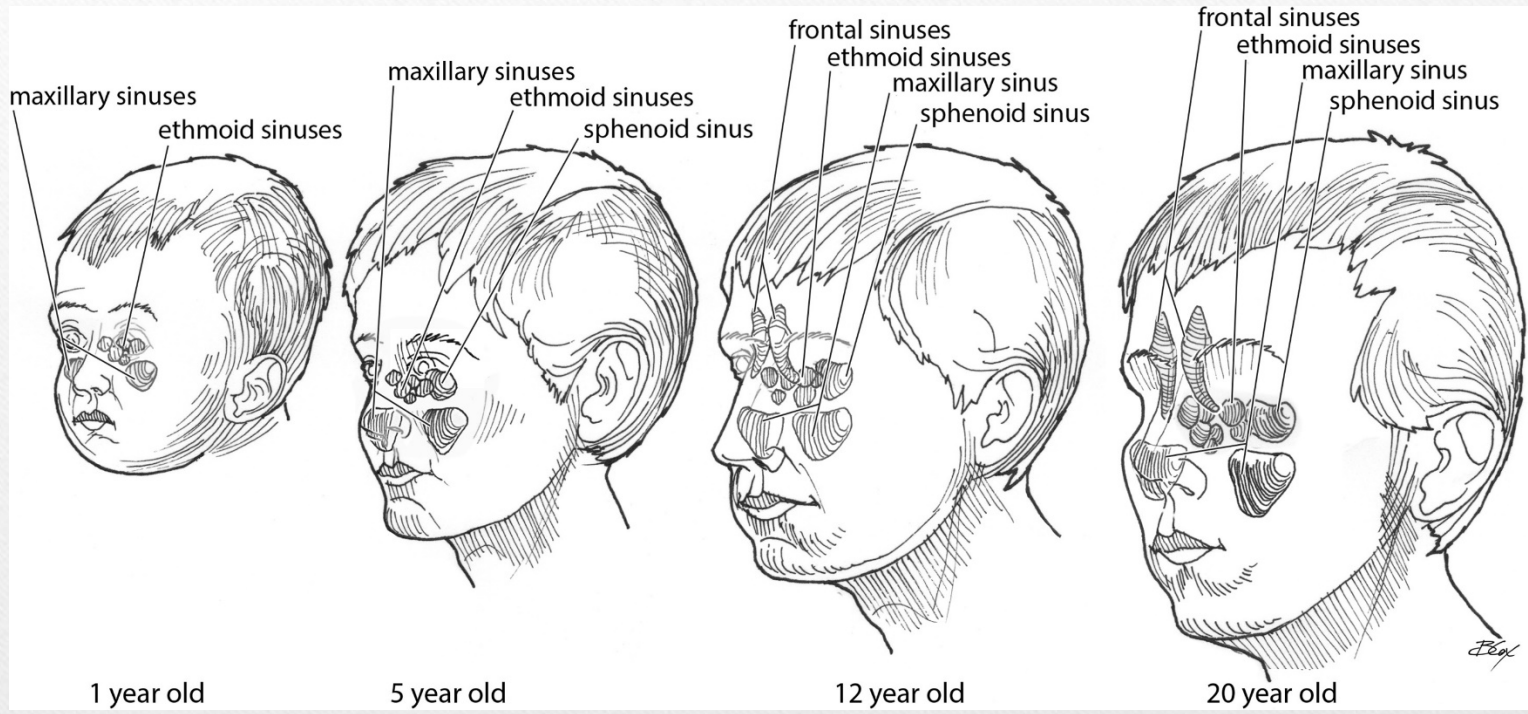
Preseptal vs Orbital cellulitis

- **Preseptal**

- No effect on VA
- Warm lids
- No fever
- EOM full
- *Pupils normal
- Obvious cause
 - Bug bite
 - Chalazion
 - Localized trauma
 - Localized inflammation

- **Orbital**

- VA affected
- Warm lids and pain
- Fever and lethargy
- EOM restricted
- *Pupils APD
- Causes
 - Sinusitis
 - Worse preseptal
 - Abscess



Clinical pearls

- Small babies/younger children less immunity
- Infection passes through tissues easily
- Hospitalization with IV antibiotics
- Rocephin
 - IM cephalosporin
 - Bacterial infections - meningitis



Case 4

- 6yo Male red eye since couple of mths
 - Not getting better has used topical meds before
 - Done warm compresses
- Meds: none, NKDA
- Gen health: good, eczema on and off
- Family history: unremarkable
- Birth history: F/T born, weighed 6lbs at birth, normal delivery

Case 4

- VA sc OD: 20/25 OS: 20/40



Case 4

- Treatment
 - Topical:
 - Occusoft scrubs / lid hygiene
 - Bacitracin ung at night
 - Tobradex/Maxitrol ung qhs
 - Artificial tears



Case 4

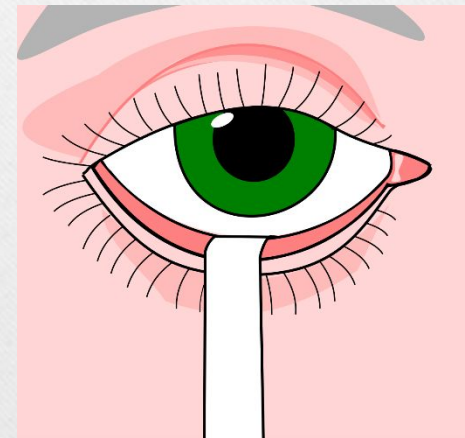
- Oral Medications
 - Azithromycin >2yo
 - **Erythromycin**
 - Tetracycline - doxycycline
 - Avoid in children < 12yo due to risk of staining teeth
 - photosensitivity in children
 - They are associated with risk for pseudotumor cerebri

Eye lid Disease and Dry eye

- Inflammatory conditions (decrease tear production)
 - Sjogren's
 - JIA
- Congenital conditions (absence of tear production)
 - Familial dysautonomia
- Poor nutrition – Vit A deficiencies
- Diabetes type 1 in children 7.7%
- Systemic antihistamines – decrease lipid production
- Environmental causes – decrease blink rate
 - Tablets/ Ipad/ virtual learning

Eye lid disease and Dry eye

- Hard to check in children
 - Schirmer's test – hard to do in kids
 - Look for overall signs and slit lamp exam
 - Rubbing eyes too much
 - Redness in eyes
 - c/o foreign body sensation
 - Test to do:
 - Tear meniscus height
 - Tear break up time >10 sec normal



Eye lid disease and Dry eyes

- Treatment options:
 - Artificial tears
 - Refresh tears
 - Optive and optive advanced
 - Two and triple active ingredients – PF
 - Lacralube
 - Systane
 - Restasis \$\$\$ >16yo
 - Oral Medications



Atopic Eye Disease

- 20 -40% Atopic dermatitis had eye disease
 - Blepharitis
 - Keratoconjunctivitis
 - Keratoconus
 - Herpetic eye disease
 - Cataracts
 - Retinal detachment

Atopic Keratoconjunctivitis

- Antihistamines
- Mast cell stabilizers
- Steroids
- Tacrolimus ung (Protopic)
 - Skin medication used in eye off label
 - Weakens the skin immune system – decreasing allergic reaction and relieving the eczema
 - Vitiligo off label use, FDA approved for atopic dermatitis
 - Doesn't thin the face skin unlike steroids
 - Tacrolimus
- Cyclosporine
 - Not FDA approved for atopic disease
 - FDA approved for vernal and dry eyes

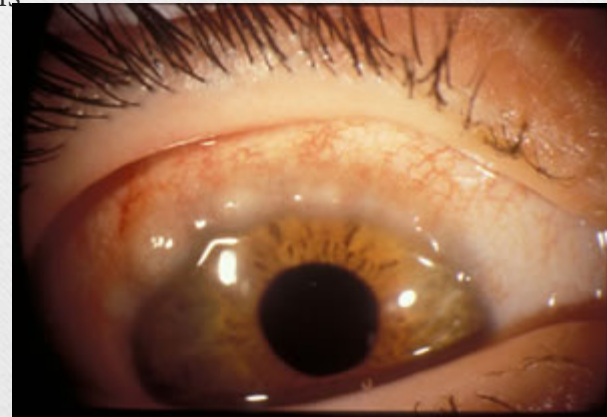
- Tacromilus ung (Protopic)

- Skin medication used around eye off label
- Weakens the skin immune system – decreasing allergic reaction and relieving the eczema
- Vitligo off label use, FDA approved for atopic dermatitis
- Doesn't thin the face skin unlike steroids
- Tacrolimus optic neuropathy
 - Seen in patients with Organ transplants
 - Medication lipophilic
 - Passes through blood brain barrier
 - Causes vasodilatation and vasogenic edema

Verkazia



- Cyclosporine A CE 0.1%
- FDA approved 2021
- QID application
- Significantly reduces clinical signs and symptoms
- Side effects
 - Eye pain (12%)
 - Eye discomfort
 - Pruritis
 - Decreased VA
 - Ocular hyperemia
 - Systemic AE: cough, pharyngitis (< 5%)



https://webeye.ophth.uiowa.edu/eyeforum/cases-i/case70/Vernal-Keratoconjunctivitis-Atopic-As-thma_Fig1.jpg

Dupilumab (Dupixent)

- FDA approved
 - Atopic dermatitis (> 6mths)
 - Most common group of ocular side effects
 - Asthma (> 6yrs)
 - Eosinophilic esophagitis (> 12 yrs)
- Monoclonal antibody
 - Injection q 2-4 weeks
 - Inhibits IL -4 and IL- 13
 - Blocks release
 - Pro inflammatory cytokines and chemokines
 - IgE

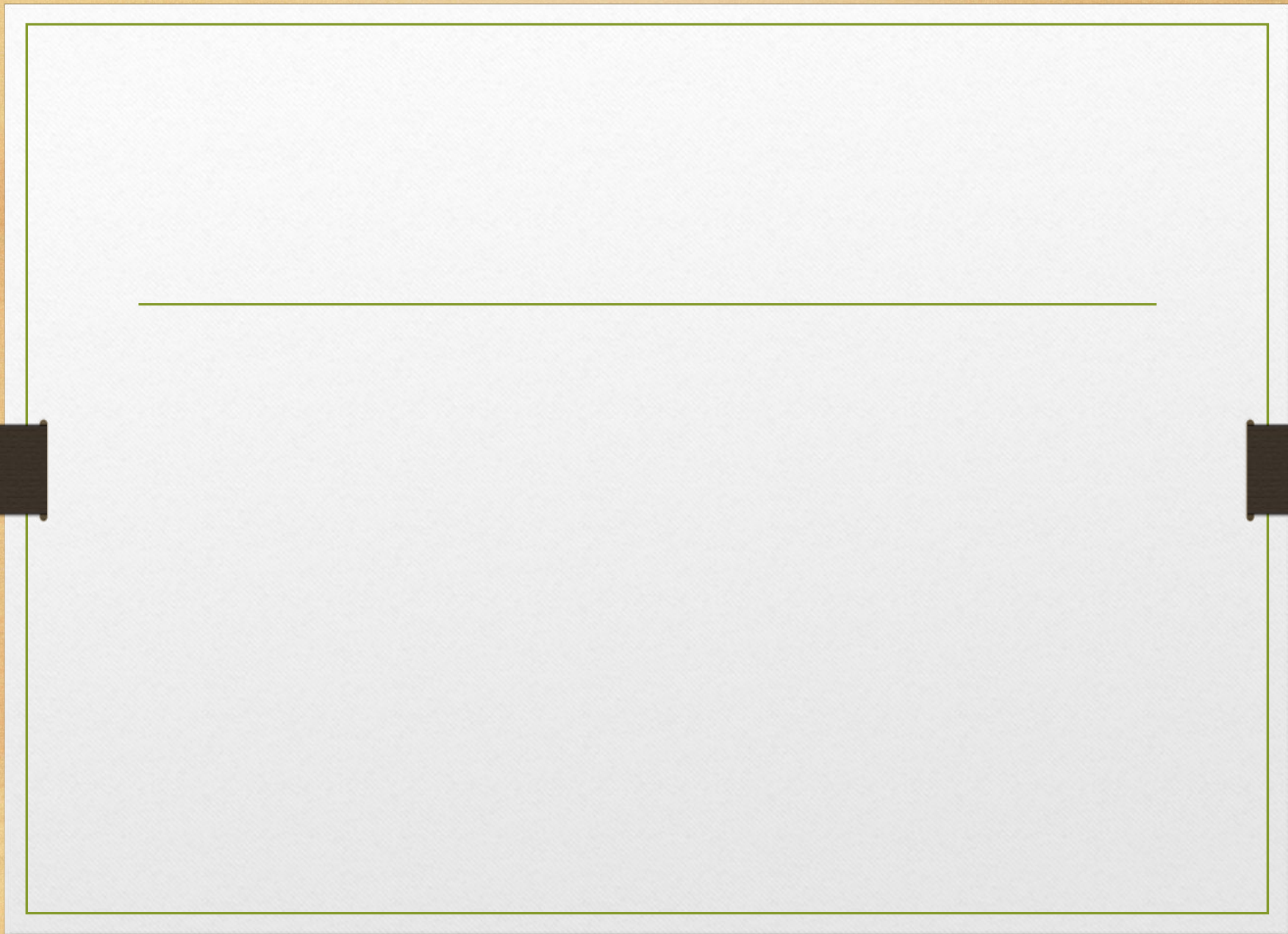
Dupilumab (Dupixent)

- Ocular side effects
 - Conjunctivitis (10%)
 - Keratitis (1-4%)
 - Blepharitis, dry eyes, itchy

JAK inhibitors

- Uses
 - Atopic dermatitis
 - RA/ JIA
 - Ulcerative colitis
- JAK inhibitors like
 - Rinvoq
 - Cibinqo
 - Olumiant
- Ocular side effects
 - Retinal detachments
 - Macular edema
 - Cataracts
 - Glaucoma





- Dilation

Dilating medications

- Cyclopentolate 0.5%, 1% or 2%
- Tropicamide 0.5%, 1%
- Phenylephrine 2.5%, 10%
- Atropine
 - 1%
 - 0.01%
 - 0.02%
 - 0.05%
- Homatropine
- Cyclomydracil
- Spray



Dilating eye drops

- **Cyclopentolate**
 - Muscarinic antagonist
 - Dilates the eye (mydriasis)
 - Paralysis of the iris muscle (Cycloplegia)
 - Iritis/ uveitis
- Side effects
 - Occ behavioral changes in kids
 - Avoid in patients with seizures
- Max cycloplegia 45mins
- Recovery of accommodation 6-24 hrs
- Recovery of mydriasis 1-2 days



Dilating Eye drops

- **Tropicamide** (mydriacyl)
 - Anticholinergic
 - Mydriasis
 - Cycloplegia
- Max cycloplegia 20-30mins
- Recovery of accommodation 4-6hrs
- Recovery of mydriasis even upto 24hrs



Dilating eye drops

- Phenylephrine 2.5%, 10%
 - Dilates the eye
- Side effect:
 - Stinging
 - Burning
 - Increased heart rate



Dilating eye Drops

- Atropine 0.01%, 0.02%, 0.5%, 1%
 - 1% uses
 - Antimuscarinic
 - Dilates pupil/ cycloplegia
 - In amblyopia treatment
 - In treatment of iritis/ uveitis
- Side effects 1%
 - Stinging, burning
 - Flushing
 - Photophobia
 - Decreased lacrimation



Dilating eye Drops

- Atropine 0.01% or 0.02%
 - Myopia control

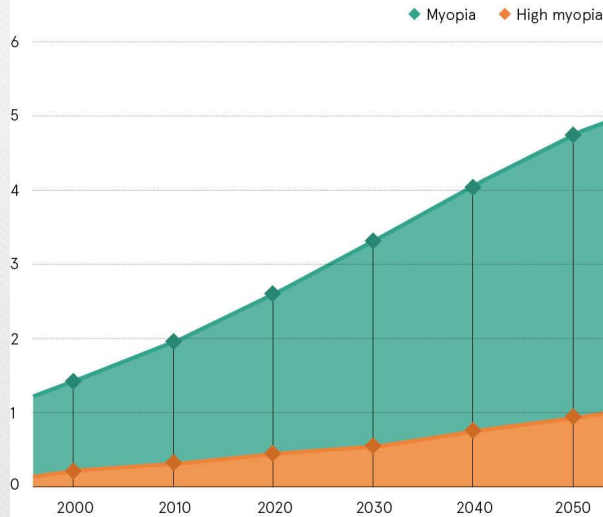


Myopia Control

- Prevalence of myopia is increasingly globally

Growing prevalence of myopia worldwide

Number of people (bn)



Growing prevalence of myopia worldwide

28%

of the world's population suffered from myopia in 2010, equal to 1.95 billion people

50%

are expected to be myopic by 2050, equal to 4.76 billion people

938m

people are predicted to suffer from high myopia by 2050, which puts them at risk of more serious eye conditions

*Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050', Ophthalmology 2016

Myopia control

TABLE 1. Complications associated with high myopia

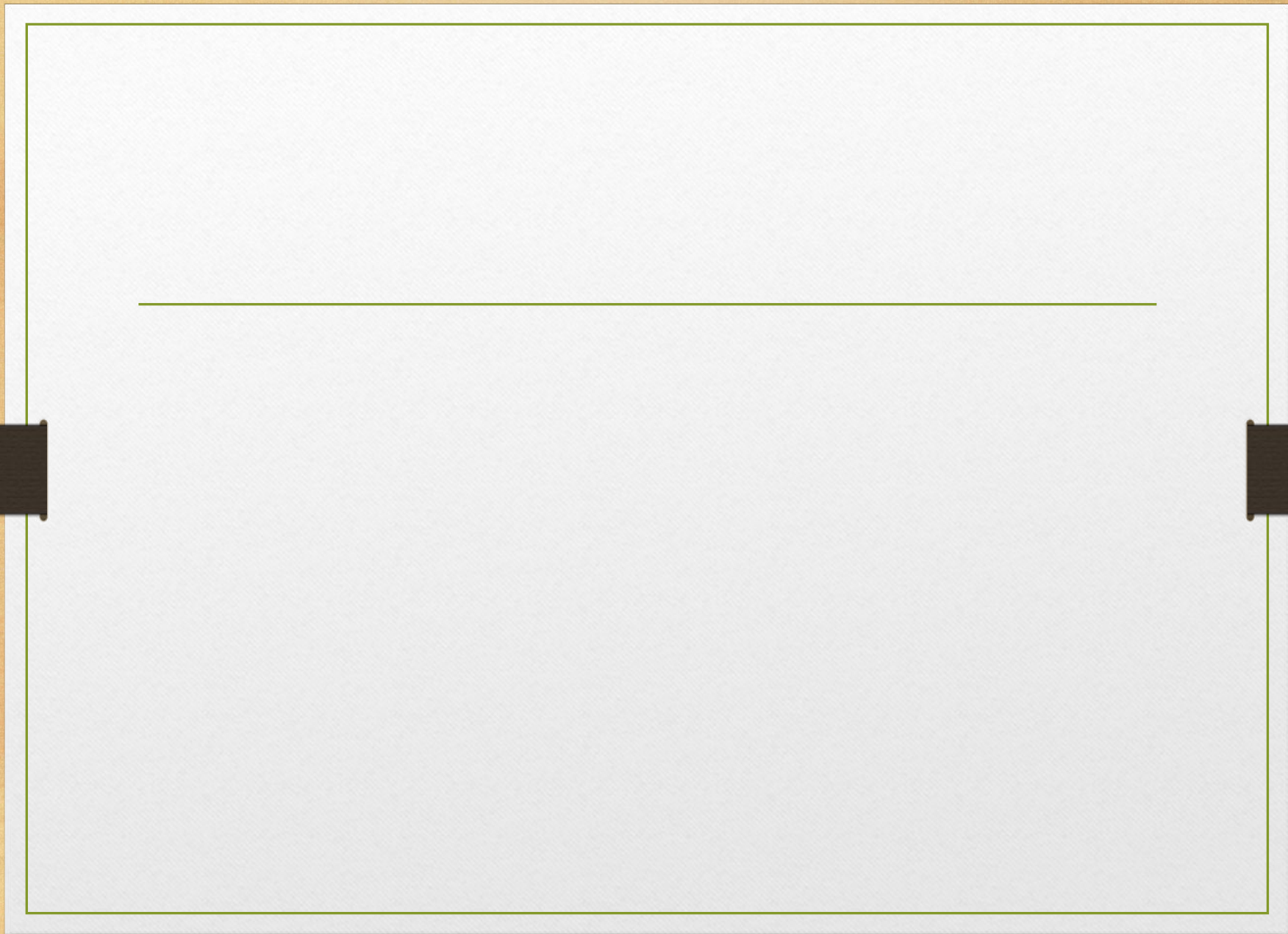
| | |
|--|--|
| Optic nerve and optic disc abnormalities | Glaucoma Peripapillary atrophy |
| Medical retinal complications | Chorioretinal atrophy Choroidal neovascularisation |
| Surgical retinal complications | Peripheral retinal degeneration Rhegmatogenous retinal detachment Myopic macular hole Myopic traction maculopathy |

Myopia Control

- LAMP study
 - Atropine 0.01%
 - Atropine 0.02%
 - Atropine 0.05%
- \$\$

Clinical pearls

- Babies < 1yr old
 - Cyclomydriacyl
 - Cyclopentolate 0.5% <1yo
- Light eyes vs dark eyes



- Steroids

Case

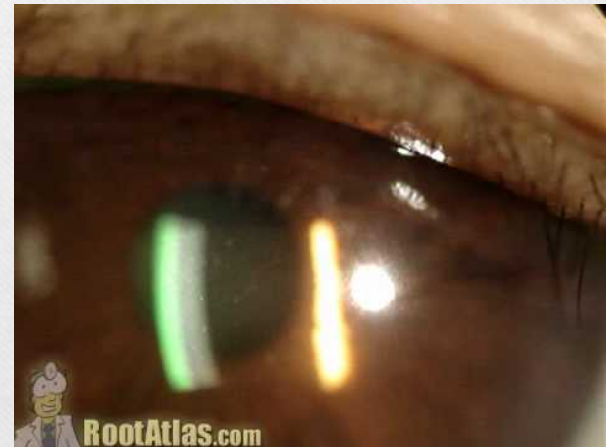
- 7yo F R/o Amblyopia failed eye exam at peds
 - Meds: none
 - NKDA
 - Gen health: good
 - F/T born, 6lbs 2 oz at birth, C section

Case

- VA sc OD: 20/200 OS: 20/80
- Pupils: PERLA no APD
- EOM: full

Case

- Slit Lamp exam
 - OU: 3+ cells and flare, mild cataract OD
- BIO exam
 - Healthy Optic nerves OU
 - Macula: Flat +FLR OU
 - Peripheral retina: normal OU



Case

- Assessment
 - Uveitis OU
 - Mild Cataract OD
- Plan
 - Systemic workup with rheumatology – JIA
 - Pred Forte q2 hrs OU
 - Cyclopentolate bid OU

Topical steroids

- **Ketone base steroids** (prednisolone and dexamethasone) or **ester based** (loteprednol)
- Human body possesses abundant esterases and no ketones
- Ketone based steroids linger in tissues giving good therapeutics but also risk for PSC and increased IOP with long term use
- Ester based steroids give potent anti-inflammatory effect, enzymatic degradation of steroid occurs minimizes potential for side effects

Topical steroids

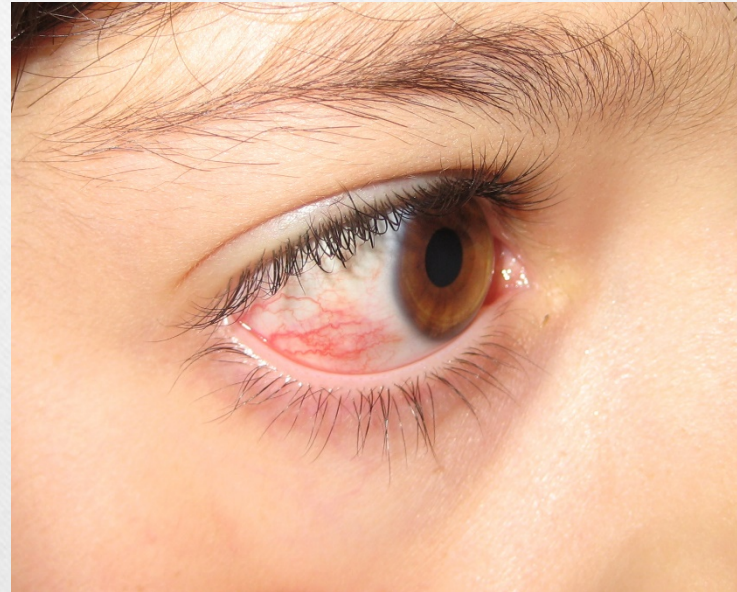
- Durezol 0.05%- difluprednate emulsion
- Predforte and generic prednisolone acetate 1% (susp)
- Vexol / dexamethasone
- Lotemax – loteprednol etabonate 0.5% (susp and gel)
and loteprednol etabonate 0.2% (susp) – alrex
- FML and generic fluorometholone alcohol 0.1%
(susp, ung)

Topical steroids - combination

- Tobradex ≥ 2 months old
 - Tobramycin 0.3% and dexamethasone 0.1%
- Zylet > 6 years old
 - Loteprednol etabonate 0.5% and tobramycin 0.3%
- Maxitrol ≥ 2 years old
 - Neomycin sulfate, polymyxin B sulfate and dexamethasone

Topical steroids

- Steroid use indications
 - Iritis/ iridocyclitis
 - Episcleritis
 - Chemical trauma
 - Corneal infiltrates
 - VKC
 - Stromal keratitis
 - Uveitic glaucoma
 - Post operative care



Topical steroids

- **Contraindications**

- Herpes simplex infectious epithelial keratitis
- Acute bacterial infections
 - Use combination drugs like zylet and tobradex
- Significant epithelial compromise
- Fungal and mycobacterial infections

- **Clinical pearl**

- Shake the bottle before use
- Always taper steroids

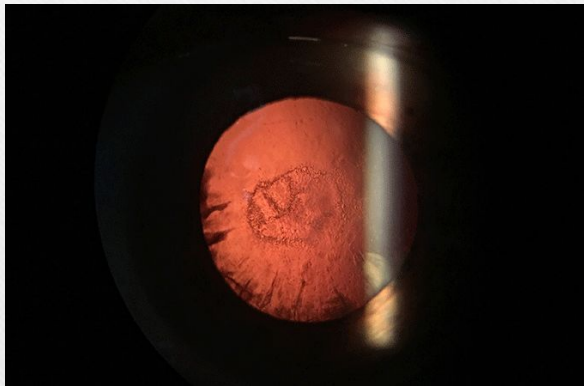
Oral steroids

- Prednisolone
- Binds to intracellular steroid receptors and modifies gene expression and protein synthesis
- Overall non specific immune response suppression
- Most common pediatric indications
 - Asthma
 - Poison ivy
 - Croup
 - Allergies
 - Autoimmune diseases – SLE, JIA
- Side effects:
 - Slowing of growth
 - Weight gain
 - Worsening of diabetes
 - Worsens of peptic ulcers
 - Reduced ability to fight off infections



Oral steroids

- Ocular risks
 - Posterior subcapsular cataract 6.4 – 38.7%
 - Steroid induced glaucoma “steroid responders” 31.5%



Pediatric Steroid Induced Glaucoma

- Exaggerated pressure response to steroids
- Glaucomatous damage compared to adults
 - Earlier onset
 - More severe at presentation
 - Progress more rapidly
- Cause
 - Structural and functional immaturity of TM

Corticosteroids – Long Term oral steroid use in children

- Ocular Hypertension

- Onset as early as 1 week
- 61- 90% in first year of use

- Dosage dependent <5mg/ per day less likely to happen

- Cataract

- Onset as early as 6mths
- Most occur at 1 – 1.5 years
- Associated with OHTN

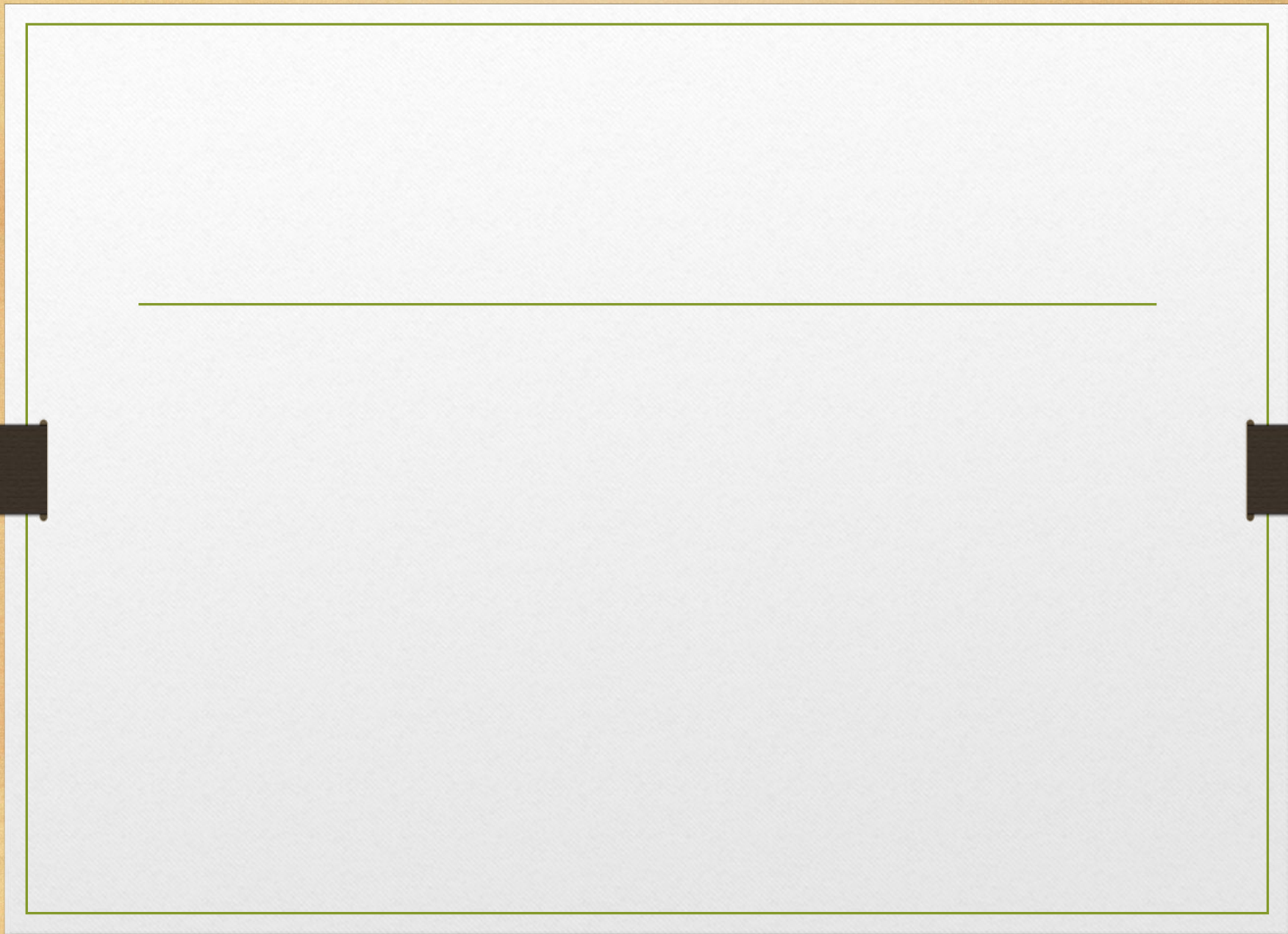
- > 10mgs / per day more likely to happen

Clinical pearl

- Why should we taper steroids??
 - Hypothalamus produces corticotropin releasing factor (CRF)
 - Travels to ant pituitary and triggers release of ACTH (Adrenocorticotrophic hormone)
 - Causes the adrenal cortex to up regulate the production of hydrocortisone and corticosterone (natural steroids)
 - Levels of natural steroids in plasma increases- ACTH decreases
 - Negative feedback helps maintain homeostasis of hydrocortisone and corticosterone

Clinical pearl

- Synthetic steroids used over long period of time adrenal cortex slows its production of physiologic steroids
- Tapering steroids – gives adrenal cortex time to start producing normal level of natural steroids again
- Stopping abruptly leaves body with low levels of steroids – hypotension, hypoglycemic
- Result in atrophy of the adrenal cortex and even suppression of pituitary function
- Systemic steroids >>> topical steroids



- Antivirals

Case 5

- 7yo Male
 - Peds referred pt, has some vesicles around the eye
 - Started 2 days ago
 - Eye feels irritated and red
 - Never happened before
- Was sick 1 week ago
- Meds: none, NKDA

Case 5

- Anterior segment



Case 5

- Treatment options
 - Topical meds
 - Zirgan gel if eye is affected
 - Erythromycin ung for lesions
 - Oral meds
 - Acyclovir
 - Both



Herpes

- Herpes simplex is common virus affecting humans
- Two types
 - **Type 1**
 - Spread through direct contact with active lesions or infected secretions
 - Spreads via peripheral sensory nerves to trigeminal ganglion
 - Latent in sensory ganglion and reactivates
 - Risk factors for reactivation:
 - Trauma
 - Atopic disease
 - Diabetes
 - Immunocompromise
 - stress
 - **Type 2** – genital infections

Herpes

- Tearing, decreased vision, photophobia, burning
- Eyelids – blisters
- Conjunctiva – redness
- Cornea
 - Epithelial dendrite keratitis
 - Stromal keratitis – scarring
 - Endothelial keratitis



Herpes

- HSV in kids **leading cause of blindness globally**
 - Hard to diagnose
- Kids any age can get infected with it
- Newborns affected- spread through kissing a baby if adult has a cold sore (kids have poor immunity)
 - Involve the CNS and other organs and be life threatening
- If you suspect herpes in little babies – hospitalize for IV antivirals

Herpes



- Children develop severe disease manifestations
 - Bilateral HSV keratitis 0- 26%
 - Frequent recurrences 38%-80% 12-15mths after initial infection
 - Corneal stromal scarring
 - Amblyopia
 - Deprivational
 - Refractive – astigmatism > 2D
- Children have 35-50% chance of having stromal keratitis
 - Increased inflammatory response

Herpes

- Herpes zoster virus causes shingles and is the same virus that causes chicken pox
- Virus remains dormant in body and reactivates later
- These infections are less common in children

Herpes

- Herpetic eye disease study > 12yrs old
 - **Epithelial keratitis**
 - Oral acyclovir 12 -20mg/kg/day in children
 - **Non necrotizing stromal keratitis or endothelitis**
 - Topical steroids
 - Oral acyclovir
 - **Necrotizing stromal keratitis**
 - No steroids
 - Active viral disease worsened with its use
 - **Recurrences**
 - In HEDS 400mg twice per day for 1 yr <40%
 - In children – no set dose
 - Oral acyclovir till active disease resolves

Clinical pearl

- After 1st episode 50% risk of 2nd one within a year
- After 2nd episode 70% risk of 3rd one

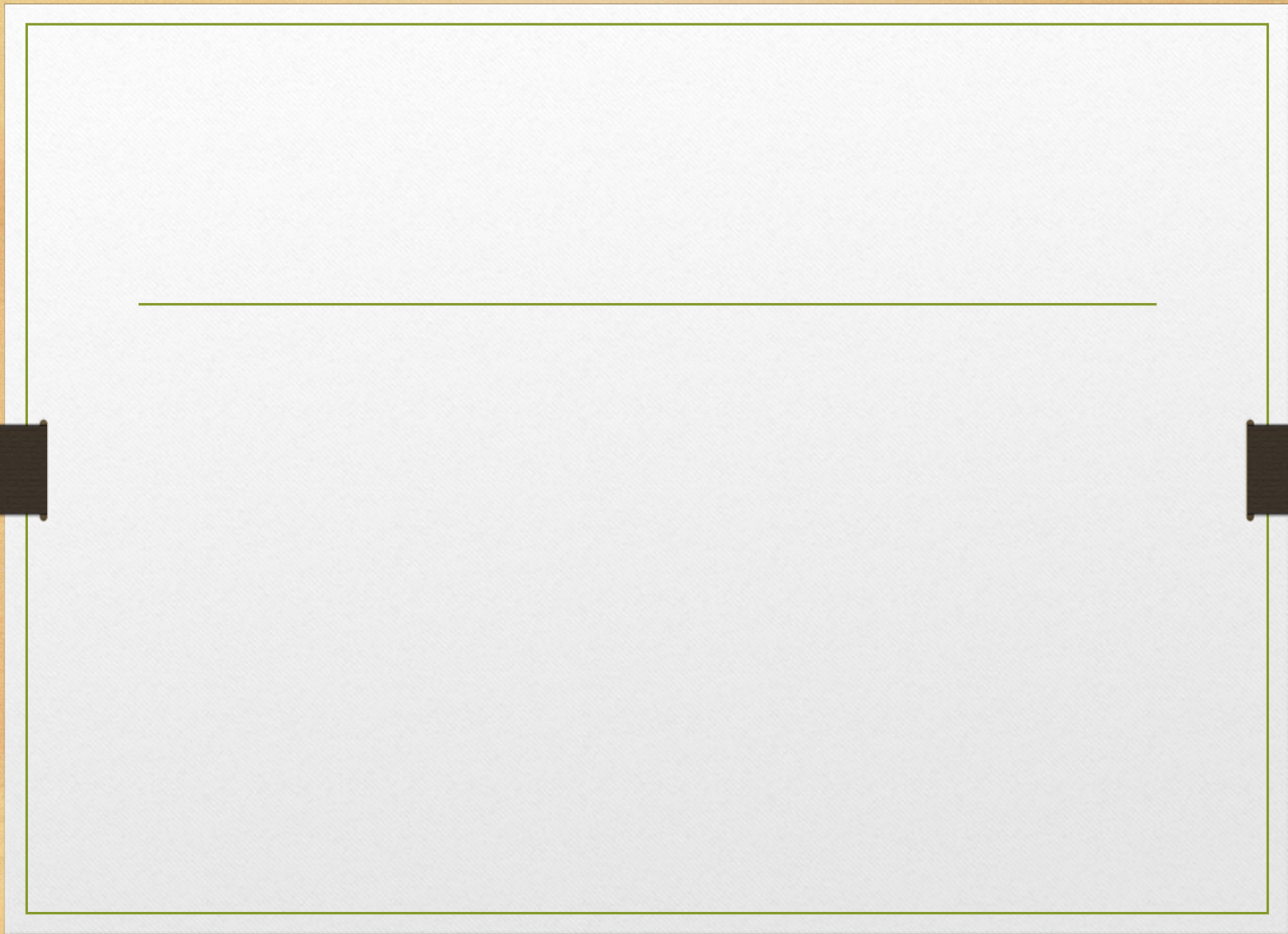
Topical Antivirals

- Viroptic 1% trifluridine
 - 1gtt 9 times per day then 5 times per day and taper off 5-10 days
 - Use > 6yo
 - Epithelial toxicity
- Zirgan gel (ganciclovir 0.15%)
 - Inhibits DNA replication of the virus
 - 5 times per day until ulcer heals then tid for 1 week
 - Use > 2yo
- Acyclovir ophthal ung 5% -zovirax cream
 - $\geq 2yo$

Oral Antivirals

- Acyclovir – zovirax oral susp.
 - >2yo, <40kg: 20mg/kg dosed qid X 5 days
 - >=2yo >40 kg: 800mg dosed qid X 5 days
 - **Lots of water**
- Valtrex (valacyclovir)
 - Cold sores >12yo
 - Chicken pox >2yo and <18yo
- Famvir (famcyclovir) >18yo



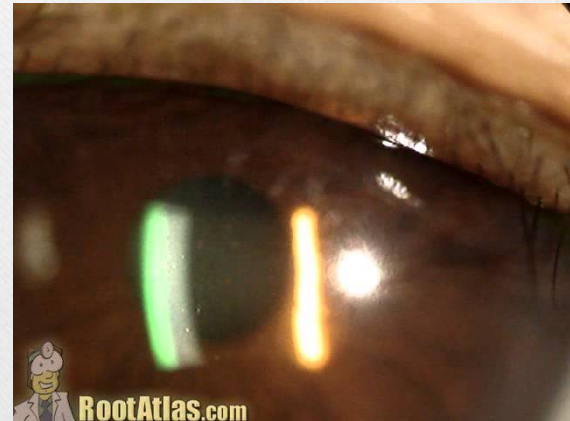


Case 6

- 10yo F here for 3-4 mth f/up JIA
 - White eye
- No complaints per pt
- Meds: methotrexate NKDA
- Sees her rheumatologist q 3mths

Case 6

- VA with glasses: OD: 20/30 OS: 20/30-2
- EOM: full
- Pupils: PERLA no APD
- Anterior segment:
 - OU: 2+cells and flare
 - No Keratic precipitates
 - No posterior synechiae



Case 6

- Refraction
 - OU: -2.00 sph 20/30 in OD, OS
- Fundus: normal, no evidence of posterior uveitis OU

Case 6

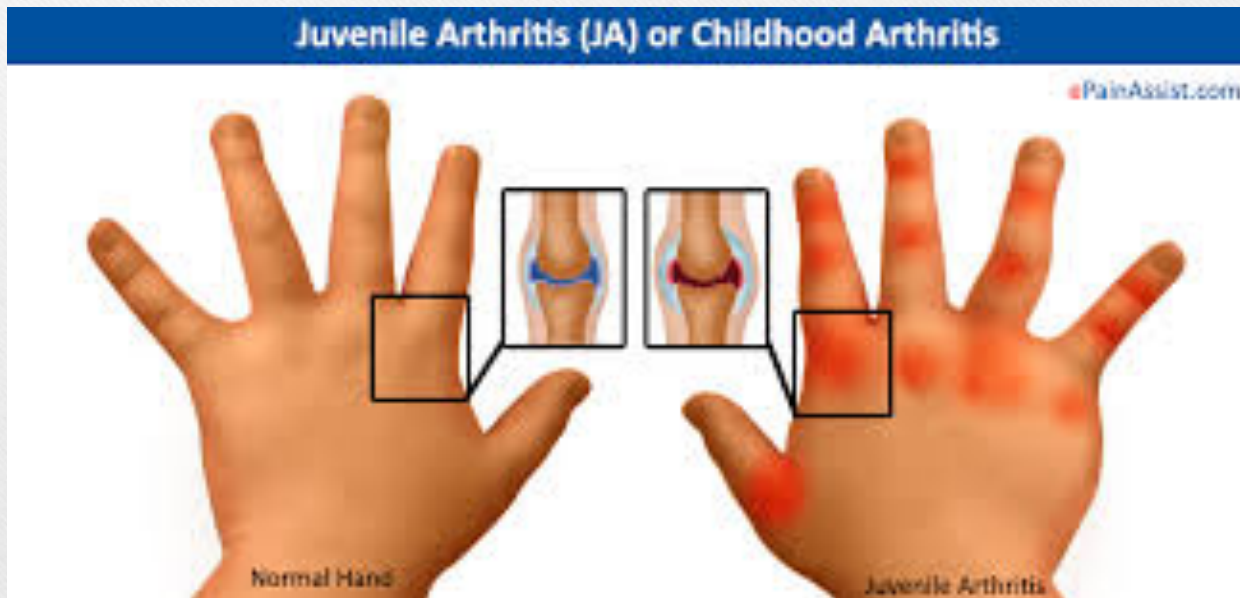
- Diagnosis
 - Uveitis sec to JIA OU
- Treatment:
 - Pred forte 1% 6 times per day OU
 - Can add FML ung at night
 - Can add cyclopentolate bid or atropine once per day
 - f/up in 1-2 weeks

Case 6

- f/up #1
 - Pt anterior segment looks better
 - Minimal flare and cells
 - Cont PF 1%
 - f/up in 1-2 weeks again

Clinical Pearl

- JIA uveitis fingers longer so taper slowly



Case 6

- f/up scenario 2
 - Pt comes in but cells/ flare are worse 4+
 - What will you do???

Case 6

- DID you use the medication prescribed???
- If yes
 - Increase PF1% qhr, FML unguent at night, cycloplegia
 - Check fundus for signs of posterior uveitis
 - Check IOP secondary to steroid use
 - If recurrent uveitis on methotrexate
 - Talk to pt rheumatologist to put on “humira”
 - It is now approved as the oral med for the tx of uveitis
 - f/up in 1-2 weeks

Case 6

- Scenario #3
 - Pt now comes in still +4 cells and flare
 - But now pt is having some vitritis as well
 - Has had one dose of humira only
 - Tx:
 - Switch to durezol short term?? Oral pred??
 - Cycloplege if necc
 - Check IOP
 - f/up in 1 week

Case 6

- Pt comes in has had 2 doses of humira
- Uveitis is getting better both ant and post
- But now, pt has increased IOP
 - 28,32mm Hg

Topical Glaucoma meds

- **Beta Blockers** >2yo
 - Timolol and generic – timolol maleate
 - Decreases IOP by reduction of AH production
 - 0.25% qday, 0.5% - 25- 30% IOP lowering
 - AH production is naturally reduced at night (adrenergic system is also at rest) – use beta blockers at am
 - **Important: not used for asthma patients and cardiopulmonary disease patients**
 - Don't use if pt is already on oral beta blocker
 - Betoptic/ betimol/betagan

Topical Glaucoma medications

- **Prostaglandins**

- Xalatan (latanoprost)
 - Long lashes, increased iris pigment
- Vyzulta (latanoprost bunod ophthalmic solution)
- Travatan and travatan Z (travoprost)
 - Travatan Z has no BAK
- Lumigan (bimatoprost)
 - Conjunctival redness
- 30% IOP lowering

Vyzulta

- Latanoprostene with nitric oxide
- FDA approved 2017
- Once daily at night
- Not reco < 16yo
- Side effects
 - Conjunctival hyperemia (6%)
 - Eye irritation/ pain
 - Lash growth
 - Iris hyperpigmentation
 - Intraocular inflammation
 - Macular edema



Topical Glaucoma medications

- **Carbonic Anhydrase Inhibitors**

- Inhibit the enzyme carbonic anhydrase which leads to the production of aqueous humor and CSF
- 15% IOP lowering
- Trusopt (dorzolamide) solution
- Azopt (brinzolamide) susp
- Bid to tid dosage

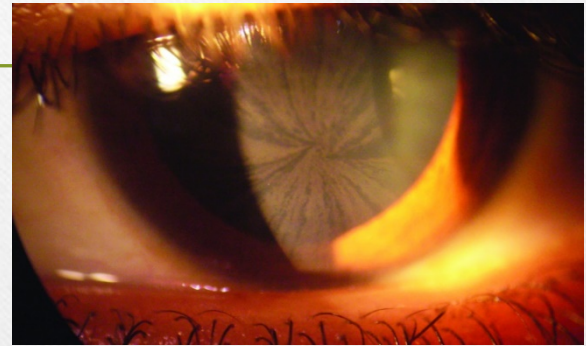
Topical Glaucoma medications

- Alpha Adrenergic Agonists
 - Alphagan (brimonidine)
 - Alphagan P – “purite” or stabilized oxychloro complex preservative – better than BAK
 - Tid for stand alone therapy, bid in combination
 - 20 – 25% decrease in IOP

Topical Glaucoma Medications

- **Rhopressa**

- Netarsudil ophthalmic solution
- FDA approved 2017
- Reduction of elevated IOP
- Open angle glaucoma/ ocular hypertension
- Once drop in the evening
- Side effects
 - Hyperemia (53%)
 - Vortex keratopathy (10%)
- Unknown effects on pregnant women



Rhopressa

- In combination with other glaucoma drops
- Option for refractory glaucoma to avoid glaucoma surgery

Topical Glaucoma Medications

- **Combination glaucoma drugs**
 - **Cosopt** - 0.5% timolol maleate and 0.2% dorzolamide HCL
 - **Combigan** – 0.5% timolol maleate and 0.2% brimonidine HCL



Oral Glaucoma Medications

- Acetazolamide – CAI
 - Increased blood sugar
 - Flushing
 - Tiredness

Case 6

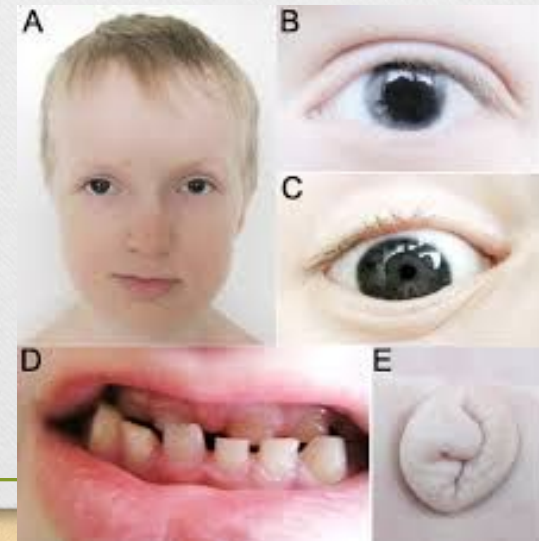
- Coming back to our JIA pt now with increased IOP
 - Can use one of the topical meds to bring the increased pressure under control
 - Timolol
 - Cosopt
 - Combigan

Pediatric Glaucoma

- **Congenital Glaucoma**
 - Present at birth
- **Infantile Glaucoma**
 - Develops between 1-24 mths
- **Juvenile Glaucoma**
 - Develops > 3yo
- **Associated with**
 - Sturge Weber syndrome
 - Axenfeld Reiger syndrome
 - Aniridia
 - Aphakia



Courtesy of Dr David Wallace, Duke Eye Center



Pediatric Glaucoma

- Incidence
 - Primary pediatric glaucoma is rare 1 in 10,000 births
 - Secondary glaucoma is higher
 - 50% kids with aniridia will develop glaucoma in their lifetime



Pediatric Glaucoma

- **Congenital/ Infantile Glaucoma**

- Excessive tearing, large cornea and cloudy cornea

- **Juvenile Glaucoma**

- No obvious signs
- Have family history
- Increased pressure and maybe large c/d ratio on regular exams
- Physiological cupping vs glaucoma



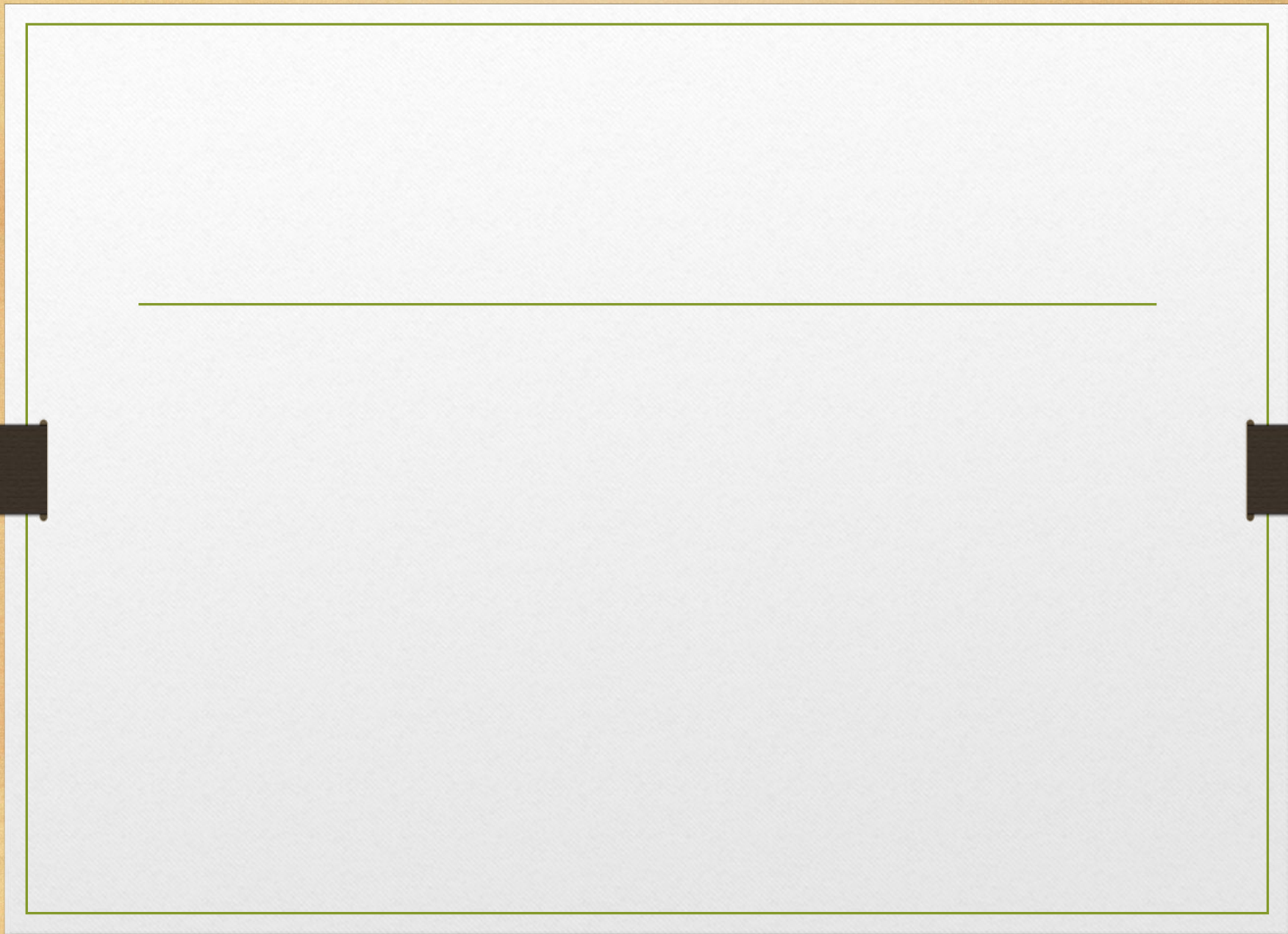
Clinical pearl

- Excessive tearing in child with matting of the lashes, d/c and sensitivity to light is not glaucoma

Pediatric Glaucoma

- Treatment using medications
- Eventually surgical procedures
 - Trabeculectomy
 - Goniotomy





- *Anti histamines*

Case 7

- 4yo Male
 - c/o itchy eyes, redness and irritation OU X 2 weeks
 - No discharge only watering
 - Otherwise healthy
- Meds: none, NKDA seasonal allergies
- Gen health: good
- Family history: unremarkable

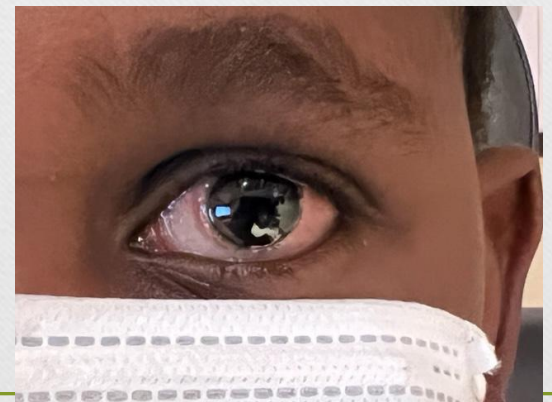
Case 7

- VA sc OD: 20/20 OS: 20/20
- EOM: full
- Pupils: PERLA no APD
- CVF: normal, OU
- Anterior segment:



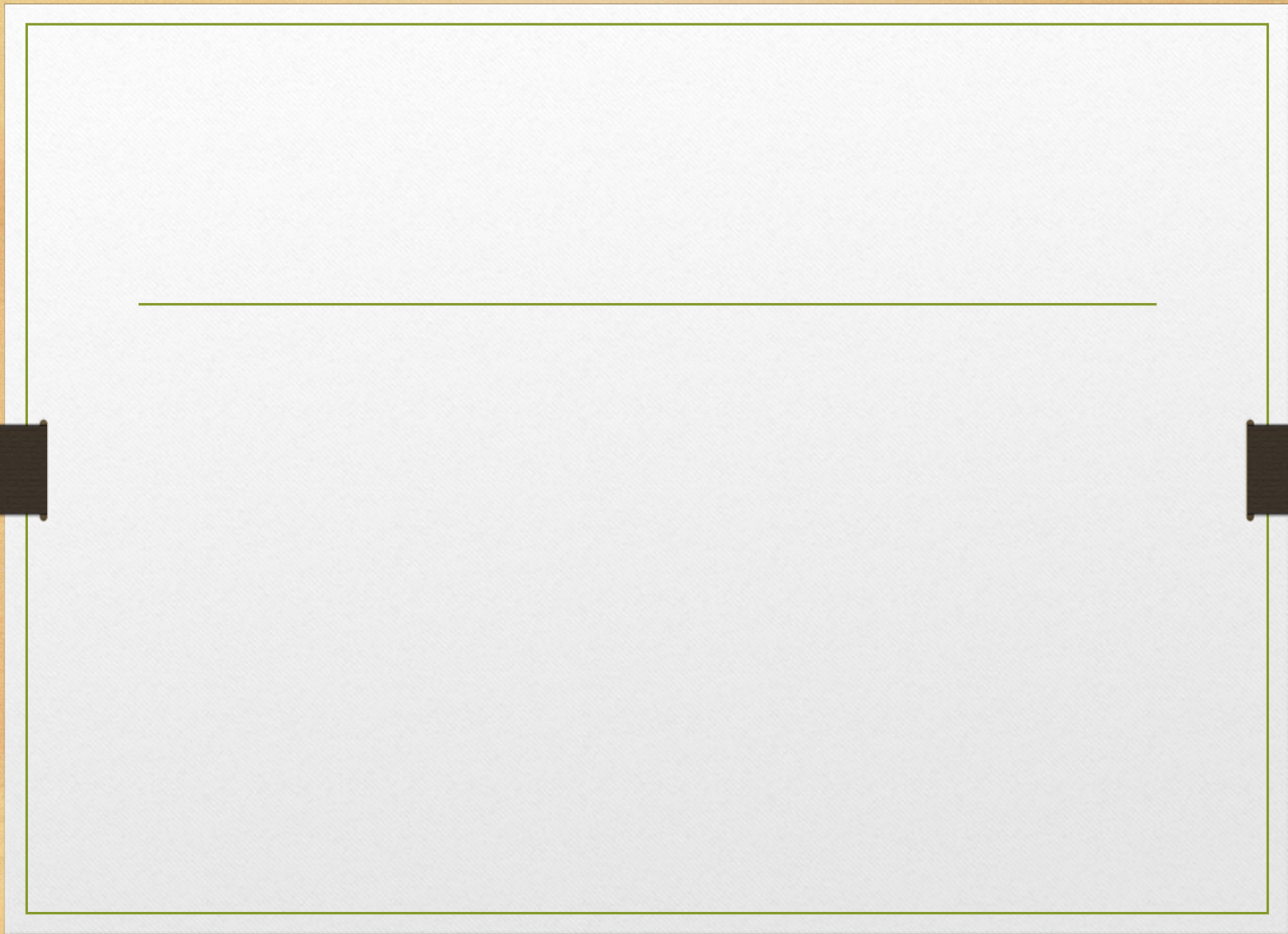
Case 7

- Treatment options
 - Antihistamine/ mast cell stabilizer
- Different scenario
 - Has a lot of conjunctival chemosis, redness and eyelid edema
 - Treatment:
 - Antihistamine/ mast cell stabilizer
 - Add soft steroid – alrex/ lotemax
 - Oral antihistamines ???



Topical Antihistamines

- Histamine H1 antagonist/ mast cell stabilizers
 - Alaway (ketotifen 0.025%) OTC bid > 3yo
 - Zaditor (ketotifen 0.025%) OTC bid >3yo
 - Elestat (epinastine 0.05%) bid >2yo
 - Optivar (azelastine 0.05%) bid >3yo
 - Pataday (olopatadine 0.2%) qday >2yo
 - Patanol bid 0.1% >2yo
 - Pazeo 0.7% qday > 2yo
 - Lastacaft 0.25% >2yo



Cautions

- Isopropyl alcohol not used in neonates
 - Chemical burns
- Brimonidine < 1-2 yrs of life
 - Respiratory depression
- Tetracyclines
 - <12yo dental discoloration



Cautions

- ASA
 - Reyes syndrome
- Gentamicin ung infants
 - Severe ant seg inflammation

Periocular ulcerative dermatitis associated with gentamicin ointment prophylaxis in newborns

[Gil Binenbaum](#), MD,^{1,*} [Christie J. Bruno](#), DO,^{2,*}
[Brian J. Forbes](#), MD, PhD,¹ [MaryAnn Snyder](#), MD,²
[Thomas J. Mollen](#), MD,² [Barbara Schmidt](#), MD, MSc,²
and [Iyalla Peterside](#), MD²

Systemic Medications

- Cystic fibrosis drugs (Ivacaftor)
 - Cataracts
- Atopic dermatitis drugs
 - Dupilumab: ocular surface disease
 - JAK inhibitors: RD
- Targeted chemotherapeutics
 - Accommodation/ dilation
 - Ocular surface disease
 - Uveitis
 - Retinopathy

Caftor drugs

- Used for CF
- ? Mechanism unclear
- Cortical and sub capsular cataracts
- No published guidelines how often to see them
 - Baseline and q 6mths
 - Patients on these drugs
 - Infants of CF moms breastfeeding

Targeted chemotherapy drugs

- Relapsing disease
- Non responding to traditional therapy
- Side effects are from adult literature

Dinutuximab (Unituxin)

- Second line for high risk neuroblastoma
- Binds to neurons and neuroblastoma cells
 - Severe neuropathic pain
 - Sensory and peripheral motor neuropathy
 - Blurred vision
 - Dilated pupils
 - Capillary leak syndrome: periorbital edema

Naxitamab (Danyelza)

- Relapsed or refractory neuroblastoma > 1yr old
- Neurological disorders of the eye
 - 19 – 24% of patients
 - Mydriasis/ unequal pupils
 - Photophobia
 - Accommodation problems
 - Blurred vision

Tyrosine Kinase Inhibitors

- Leukemias
- FDA approved in children
 - Dasatinib
 - Nilotinib
- Ocular side effects
 - Conjunctivitis
 - Keratitis
 - Photophobia
 - Blurred vision

BRAF/ MEK Inhibitors

- CNS tumors
- BRAF (vemurafenib, dabrafenib)
 - Dry eyes/ conjunctivitis
 - Uveitis
- MEK (selumetinib, cobimetinib, trametinib)
 - MEK inhibitor retinopathy 90%
 - Serous retinopathy
 - Macular edema
 - Chorioretinopathy
 - Usually mild, self limited, resolve

Vigabatrin

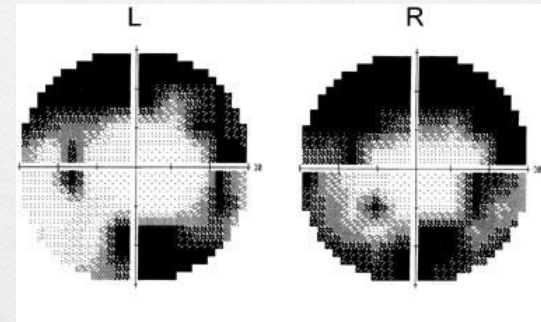
- Sabril
- Second generation anti epileptic drug
- Increases GABA
- Infantile spasms (monotherapy)
- Refractory complex partial sz (adjunct therapy)
- TS – associated sz

Vigabatrin



- Adverse side effects

- Dose dependent
- Ocular toxicity
- “inverse” nasal optic atrophy
- Loss of peripheral NFL with relative sparing of the macula
- Sensitive test 30-2 constricted visual fields/ OCT
- More GABA on retinal photoreceptors and ganglion cells
- Cumulative dose > 1500gms



Vigabatrin

- VGB risk evaluation and mitigation strategy
 - At start of treatment
 - Q 3 mths during tx
 - 3-6 mths after tx
- CHOP and UCSF 0.7% has toxicity sec to VGB

Hydroxychloroquine

- Plaquenil
- Works by
 - Inhibiting lysosomal antigen processing
 - Inhibiting TLR functions
- Pediatric indications
 - Malaria
 - Dermatomyositis
 - Systemic lupus Erythematosus

Hydroxychloroquine

- Adverse systemic effects
 - Nausea
 - Stomach cramps
 - Diarrhea
 - Serious neuropsychiatric adverse events
 - Skin reactions
 - Stevens johnson syndrome
 - TEN (Toxic epidermal necrosis)

Hydroxychloroquine

- Bull's eye maculopathy
- Irreversible
- For first 5- 10yrs, very low risk in adults if used between 4-5mg/kg then increases rapidly



Hydroxychloroquine

- AAO 2016
 - Start of medication to get baseline
 - Annual exams > 5yrs
 - Annual exams for pediatric patients
- Testing
 - HVF
 - SD – OCT
 - FAF (as indicated)
 - Mf ERG (as indicated)

Topamax

- Topiramate – sulfa derivative monosaccharide
- Migraines
- Partial and generalized sz
- Off label use for weight loss
- 3mths of use
 - Myopic shift in refractive error
 - Angle closure glaucoma
 - Ocular pain



-
- Thank you for your attention

