Pediatric Pharmacology and Pathology

Valerie M. Kattouf O.D., F.A.A.O.
Illinois College of Optometry
Chief, Pediatric Binocular Vision Service
Associate Professor
In the next 2 hours......

- Ocular Medications and Children
- Brief review of examination techniques/modifications for children
- Common Presentations of Pediatric Pathology
Ocular Medications & Children

- **The rules:**
  - birth → 2 years old = 1/2 dose
  - 2-3 years old = 2/3 dose
  - > 3 years old = adult dose

- If only 50 % is absorbed may be 10x maximum dosage
Pediatric systems differ in:

- **drug excretion**
  - kidney is the main site of drug excretion
  - diminished renal immaturity

- **biotransformation**
  - liver is organ for drug metabolism
  - Impaired enzyme immaturity

- Punctal Occlusion for 3-4 minutes ↓ systemic absorption by 40%
**Ocular Medications & Children**

- **Systemic absorption occurs through.....**
  - Mucous membrane of Nasolacrimal Duct
    - 80% of each gtt passing through NLD system is available for rapid systemic absorption by the nasal mucosa
  - Conjunctiva
  - Oropharynx
  - Digestive system (if swallowed)
    - Modified by variation in Gastric pH, delayed gastric emptying & intestinal mobility
  - Skin (2 overflow from conjunctival sac)
    - Greatest in infants
      - Blood volume of neonate 1/20 adult
      - Therefore absorbed meds are more concentrated at this age
Ocular Medications & Children

- Ocular Meds with strongest potential for pediatric SE:
  - 10% Phenylephrine
  - 2% Epinephrine
  - 1% Atropine
  - 2% Cyclopentolate
  - 1% Prednisone
Ocular Medications & Children

- Distribution to Site of Action in Pediatric Patients determined by:
  - Size of body fluid compartment
  - Muscle mass
  - Fat storage
  - Tissue blood flow
  - Protein binding capabilities

- Package inserts warn
  - "safety and efficacy has not been established in children"
  - FDA recognizes that accepted medical practice often includes prescribing medications for use in patient populations that are not included in approved labeling (PDR ophthalmology)
Package inserts warn

“safety and efficacy has not been established in children”

- FDA recognizes that accepted medical practice often includes prescribing medications for use in patient populations that are not included in approved labeling (PDR ophthalmology)
MODIFICATION OF AN EYE EXAMINATION FOR THE PEDIATRIC PATIENT
Pediatric Examination Procedures

- Case History
- Visual Acuity
- EOM
- Pupils
- Refractive Error Assessment
- Alignment / Posture
- Anterior Segment Evaluation
- Posterior Segment Evaluation
Case History

- **Perinatal History**

  - *Full term?*
  
  - *Complications during pregnancy / delivery?*
  
  - *Birth weight / prematurity*
    - 5 lb 8 oz = normal
    - Premature = < 37 weeks
  
  - *Oxygen exposure?*
Case History

- Medical History
  - Medications?
  - Allergic to medications?
  - Allergies?
  - Review of Systems
  - Has the child ever been hospitalized?
Visual Acuity
OCULAR MOTILITY EXAMINATION
Goal of the pediatric eye examination......

Rule OUT Amblyogenic Risk Factors
NLDO Patient

- **7 month old male**
  - c/o tearing OU since 2 mo of age
  - Hx of asthma / allergies (Albuterol / Claritin)
  - Recurrent discharge OU

- **Anterior Segment Examination**
  - 2+-3+ Blepharitis
  - (+) purulent discharge in both eyes
  - 3+ tear prism OD, OS

- **Assessment / Plan**
  - NLDO with 2° Bacterial Conjunctivitis OD
  - Rx Polytrim qid OD x 2 week
  - Warm compress / Hydrostatic Massage qid
  - RTC 1 week
NLDO Patient

2 week F/U, 8 month old male

- Excellent compliance with treatment, no more tearing
- No discharge or staining
- Cycloplegic Retinoscopy - +5.00 -0.50 x 180 OU

Assessment / Plan

- Resolved NLDO
  - d/c Polytrim, RTC if symptoms recur
  - High Hyperopia – above age appropriate
    - RTC 3 months to repeat cycloplegic refraction
Anterior / Posterior Segment

- 20D Lens
- Hand Held Slit Lamp
- Burton Lamp
- BIO
- Direct Ophthalmoscope
Anterior Segment Examination Guidelines

- **Lids / Lid Margins**
  - Observe for:
    - Shape irregularity
    - Discharge on lashes/lid margin
  - Evert Lower lids to expose
    - Bulbar/ Palpebral conjunctiva, observe for:
      - Follicles
      - Papillae
      - Discharge
      - Edema

- **Cornea / Iris / Lens**
  - Observe clarity / opacities/ irregularity
Anterior Segment Norms

- Corneal Horizontal Diameter in Neonate
  - 9-10 mm
- Corneal Horizontal Diameter in a 1 year old
  - 11 mm
- Corneal Horizontal Diameter in Adult
  - 11.5 – 12.0 mm
    - Reached by 3-4 years
Anterior Segment Norms

- **Pupils**
  - Size
    - Constricted - 1.2 - 2 mm
    - Fully dilated - 7.5 – 8 mm
    - Resting – 2.5 - 4 mm
  - In infancy pupillary rxn to light less than in childhood
  - Often absent in very premature infants (1st response at 28-32 wks)

- **IOP**
  - 8-15 mmHg
  - Increases by 1 mmHg/yr from birth to age 5
Posterior Pole Evaluation

- **Optic Nerve Head**
  - Color
  - Size
  - Symmetry

- **Macula**
  - Integrity / reflex

- **Vessels**
  - Tortuosity / attenuation

- **Minimal peripheral views**
Ocular Pharmaceuticals

Side Effects of Diagnostic Pharmaceutical Agents in Children
<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Example</th>
<th>Ocular/Local Side Effect</th>
<th>Systemic Side Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenergic Agonist</td>
<td>Phenylephrine</td>
<td>Conjunctival Blanching</td>
<td>Hypertension, tachycardia, arrhythmias</td>
</tr>
<tr>
<td>Cholinergic Agents</td>
<td>Cyclopentolate</td>
<td>Ocular irritation, follicular conjunctivitis, cutaneous hyperemia</td>
<td>Hyperactivity, restlessness, delirium, seizures, GI disturbance, temperature elevation, respiratory depression</td>
</tr>
<tr>
<td></td>
<td>Atropine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tropicamide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Side Effects of Diagnostic Pharmaceutical Agents in Children

- Phenylephrine risks
  - Hyperthyroidism and cardiovascular problems
    - may result in tachyarrhythmia

- Premature / ROP patients =↑systemic side effects
  - Use Cyclomydril 0.2% cyclo / 1 % phenylephrine
    - no increased blood pressure

- Cholinergic Agents
  - Education: parents may call with dilation concerns not expecting it to last into next day
  - Atropine toxicity more susceptible to
    - Lightly pigmented
    - Brain damage
    - Down Syndrome
Treatment with Atropine

- Proper patient selection...
  - Moderate-high hyperopia
  - Moderate amblyopia (20/100 or better visual acuity)

- Administration schedule
  - 1 gtt 1.0% Atropine sulfate daily vs. weekend only
    - frequency of installation can be reduced as acuity improvement is observed
    - minimal installation is one drop of 1% Atropine sulfate two times per week

- Side Effects / Emergency contact information
Atropine Instillation for Amblyopia

Our evaluation found that ________________________ has amblyopia of the right / left / both eyes.

Amblyopia is reduced vision in an eye that has not received adequate or appropriate use during early childhood, often known as “lazy eye”, and has many causes which have been explained by your doctor. If not treated, the amblyopic eye may never develop good vision and may even be functionally blind.

The treatment of amblyopia may require multiple therapy methods in which your doctor may prescribe occlusion therapy with patching or atropine instillation. Active amblyopia vision therapy may be recommended to enhance the effectiveness of occlusion therapy. Glasses are also prescribed in most cases.
The following Atropine instillation program is prescribed:

Prescription glasses should be worn for:  full time / near activities / distance activities

Install 1 Drop Atropine into the RIGHT / LEFT eye on the indicated days:

Monday   Tuesday   Wednesday   Thursday   Friday   Saturday   Sunday

***please keep medication out of reach from other family members***

Special Instructions:  _________________________________________________________________

Possible Atropine Ophthalmic Solution Side Effects:

Burning/stinging/redness of the eye, eye irritation, or temporary blurred vision may occur. Most people do not experience serious side effects from using this medication.

Tell your doctor immediately if any of these unlikely but serious side effects occur: dizziness, fainting, new or increased eye pressure/pain/swelling/discharge, rash, or itching/swelling (especially of the fact/tongue/throat. Rare, but very serious side effects include: slow/shallow breathing, mental/mood, fast/irregular heartbeat.

Your next appointment is on ______________. If you have any questions, please feel free to contact us at (312) 949-7280 or after hours via our EMERGENCY number at (312) 225-6200.
Ocular Pharmaceuticals

Commonly Used Ocular Anti-Biotic Medications in Children
Administration of Ocular Meds
Ointment vs. Drops

- **Ointment**
  - blurred vision
  - ↑ contact dermatitis

- **Drops**
  - ↑ risk of systemic toxicity
  - ↓ contact time with cornea (diluted by tears)
Ocular Medications & Children

*Anti-biotic Ointments*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>&gt; 2 months</td>
</tr>
<tr>
<td>Tobrex</td>
<td>&gt; 2 months</td>
</tr>
<tr>
<td>Ciloxan</td>
<td>&gt; 2 years</td>
</tr>
<tr>
<td>Polysporin</td>
<td>&gt; 2 years</td>
</tr>
</tbody>
</table>
# Ocular Medications & Children

## Anti-biotic Drops

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polytrim</td>
<td>≥ 2 months</td>
</tr>
<tr>
<td>Azasite</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Besivance</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Ciloxan</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Ocuflox</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Quixin</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Vigamox</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Zymar</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Zymaxid</td>
<td>≥ 1 yr</td>
</tr>
<tr>
<td>Iquix</td>
<td>≥ 6 yr</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>unknown</td>
</tr>
<tr>
<td>Sulfacetamide</td>
<td>unknown</td>
</tr>
</tbody>
</table>
Ocular Medications & Children

**Anti-biotic Drops**

- **Polytrim** – Broad spectrum, effective, inexpensive

- **AzaSite** – macrolide anti-biotic (Z-pack)
  - Prolonged ½ life - ↓ dosing schedule
  - 1 gtt q 8-12 hrs (tid) x 2 days
  - 1 gtt qd x 5 days
  - Broad spectrum, effective, expensive
Ocular Medications & Children

Anti-biotic Drops

• **Fluoroquinolones** (concentration dependent)

  • **Besivance** (0.6%) – new, Advanced A-B
    ▪ Vehicle: DuraSite mucoadhesive – provides enhanced ocular surface residency time
    ▪ Dosing = tid (q 8 hrs)
    ▪ Pediatric schedule: AM → after school → at bed time
  
  • **Ciloxan** (0.3%)
  • **Ocuflox** (0.3%)
  • **Quixin** (0.5%)
  • **Vigamox** (0.5%)
  • **Zymar** (0.3%)
  • **Zymaxid** (0.5%) ↑ concentration may enhance clinical results
  • **Iquix** (1.5%)
Commonly Used Ocular Allergy Medications in Children
# Ocular Medications & Children / Topical Allergy Drops

## Anti–histamine/ mast cell stabilizer

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pataday/Patanol</td>
<td>≥3 years old</td>
</tr>
<tr>
<td>Lastacaft</td>
<td>≥2 years old</td>
</tr>
<tr>
<td>Elestat</td>
<td>≥3 years old</td>
</tr>
<tr>
<td>Bepreve</td>
<td>≥2 years old</td>
</tr>
<tr>
<td>Optivar</td>
<td>≥3 years old</td>
</tr>
</tbody>
</table>

## Anti–histamine/ mast cell stabilizer

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaditor</td>
<td>≥3 years old</td>
</tr>
<tr>
<td>Claritin Eye</td>
<td>≥3 years old</td>
</tr>
<tr>
<td>Refresh Eye Itch Relief</td>
<td>≥3 years old</td>
</tr>
<tr>
<td>Alaway</td>
<td>≥3 years old</td>
</tr>
</tbody>
</table>

## Topical Corticosteroid Rx

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alrex</td>
<td>≥3 years old</td>
</tr>
</tbody>
</table>
Ocular Pharmaceuticals

Commonly Used Ocular Medications in Children/ Additional Agents
## Ocular Medications & Children
### Additional Treatment Agents

<table>
<thead>
<tr>
<th>Steroids</th>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>FML</td>
<td>≥2 years</td>
<td></td>
</tr>
<tr>
<td>Alrex</td>
<td>≥3 years</td>
<td></td>
</tr>
<tr>
<td>Lodemax</td>
<td>≥3 years</td>
<td></td>
</tr>
</tbody>
</table>
## Ocular Medications & Children
### Additional Treatment Agents

<table>
<thead>
<tr>
<th>Steroid/Antibiotic Combination</th>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tobradex</td>
<td>≥2 years</td>
</tr>
<tr>
<td></td>
<td>Blephamide</td>
<td>≥6 years</td>
</tr>
<tr>
<td></td>
<td>Zylet</td>
<td>≥3 years</td>
</tr>
</tbody>
</table>
Ocular Medications & Children

**Topical Steroids**

- **Tobradex** has *dexamethasone* as steroid agent known to increase IOP

- **Alrex**
- **Zylet**
- **Lotemax**
  - Have *loteprednol* as steroid agent = less likely to increase IOP
Ocular Medications & Children

Topical Steroids

• **Alrex (0.2% Lodelprednol)**
  • Approved for treatment of seasonal allergic conjunctivitis
  • Lubricant included/ increases comfort (viscous nature for soothing)

• **Lotemax (0.5% Lodelprednol)**
  • Use for intraocular inflammation
    ▪ Anterior uveitis
    ▪ Post-op
    ▪ Ocular allergy / GPC

• **Zylet (0.5% Lodelprednol)**
  • Treatment of inflammation + Ocular surface disease
  • Conjunctivitis/ blepharoconjunctivitis
## Ocular Medications & Children

### Additional Treatment Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>Age Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viroptic</td>
<td>≥6 years</td>
</tr>
<tr>
<td>Zirgan</td>
<td>≥2 years</td>
</tr>
</tbody>
</table>
Ocular Medication Installation
Tips for ocular medication administration

- **Drop administration**
  - Immobilize child
  - Retract lower lid
  - *Single* drop in cul de sac

- **Alternative method**
  - Patient supine
    - Drop in inner canthus while eyes are closed
      - Confirm that medication reaches tear film when eyes are open
      - Wipe excess fluid from cheek
      - When done properly ocular absorption is comparable to the conventional installation method
Instructions for home use

- Emergency contact number

- Diagnosis

- Name of medication
  - Dosage Instructions
    - Which eye(s)
    - How many times per day
    - When to discontinue

- Follow-up visit date(s)
Topical Ocular Agents

*Instructions for home use*

- Emergency contact number
- Diagnosis
- Name of medication
  - Dosage Instructions
    - Which eye (s)
    - How many times per day
    - When to discontinue
- Follow-up visit date(s)
Prescribing Oral Medications to Children
Prescribing for Children: Guidelines & Helpful Hints

- Children \(\geq 12 \text{ years and older} \) = dosed as adult

- Children \(\leq 11 \text{ years} \)
  
  - Look up dosage – given in mg/kg/day
  
  - Determine weight in kg – 1kg = 2.2lbs
  
  - Mg x Kg = DAILY dose
  
  - Divide daily dose to get desired doses per day
  
  - Choose closest available dosage strength
**PEDIATRIC SAMPLE: Augmentin Rx for 40lb, 5 yo with preseptal cellulitis**

- Augmentin = **20-40 mg/kg/day** in divided doses every **8-12 hours**
  - Available in 125mg/5 ml and 250mg/5ml suspensions *[1tsp = 5ml]*

- **[1kg=2.2lbs]** 40 lb ÷ 2.2 = **18kg**

- 40 mg/kg/day x 18kg = **720mg/day** (DAILY dose)

- 720mg/day ÷ 3 = **240mg q8h**

- Choose closest available strength by rounding to **250mg q8h**; 150ml gives 10 day course

- **PRESCRIBE:** Augmentin 250mg/5ml
  1 tsp q8h x 10 days
**Oral Anti-Biotics**

- *Children with no Penicillin Allergy*
  - **Penicillin V** x 10 days
    - children < 30kg/65 lbs = 250mg bid
    - children > 30kg/65 lbs = 500mg bid
  - **Amoxicillin** x 10 days
    - children < 30kg/65 lbs = 40mg/kg/day
    - children > 30kg/65 lbs = 250mg tid
Oral Anti-Biotics

- **Children with Penicillin Allergy**
  - *(for children < 60 lbs)*

  - **Erythromycin** x 10 days
    - 40mg/kg/day tid

  - **Azithromycin (Zithromax)** x 5 days
    - 12mg/kg qd

- **Cephalexin (Keflex)**
  - 25-30 mg/kg
  - ≤ 4000 mg/day
Prescribing for Children: Guidelines & Helpful Hints

- **Consult pediatrician for children ≤ 5 years of age**

- **In most cases prescribe the highest recommended mg/kg/day**

- **Pharmacists are very helpful in dosing**

- **For drug information:**
  - Epocrates.com
  - Drugs.com
Anterior Segment Pathology

Pediatric Red Eyes / Conjunctivitis
Differential Diagnosis

The Pediatric Red Eye

- **Conjunctivitis**
  - Bacterial
  - Viral
  - Allergic
Rules of Thumb

- If itches, it’s allergic
- If it burns, it’s dry eyes
- If eye cannot open in the AM it is likely bacterial
- If they have a cold it is viral
CONJUNCTIVITIS

Bacterial vs. Viral

DIFFERENCES
Conjunctival Discharge
Conjunctival Response
Systemic Associations

Determination important because it drives decisions about treatment and school exclusion

SIMILARITIES
Bilateral
Eyelid Swelling
Conjunctival Erythema
Viral Conjunctivitis

- Typically caused by adenovirus

- Signs
  - Watery discharge (*typically bilateral??*)
  - Erythema
  - Conjunctival response = follicular
  - Often in presence of a viral URI (upper respiratory infection)
    - *May have palpable pre-auricular node often on more affected side*

- *Most common conjunctivitis seen in school aged children*
Viral Conjunctivitis Tx

- **Treatment Options**
  - *Self limiting therefore supportive treatment*
    - Artificial Tears
    - Cool Compress
  
  - *Instruction of proper hygiene / avoidance of family members*
  
  - *Discuss daycare / School attendance issues*
    - *Frequently asked questions.......*
      
      - *How long does conjunctivitis/pink eye last?*
        - Signs and symptoms of conjunctivitis usually improve within three to seven days.
      
      - *When is it appropriate for a child to return to school or child care?*
        - When tearing and discharge are no longer present
Bacterial Conjunctivitis

- Typically caused by *haemophilus influenzae / streptococcus pneumoniae*

- **Signs**
  - Purulent discharge
  - Minimal erythema
  - Conjunctival response = follicular + papillary
Bacterial Conjunctivitis Tx

- Less likely to use:
  - Gentamycin – Corneal Toxicity
  - Sulfacetamide - ↑ allergies / SJS
  - Chloramphenicol – aplastic anemia

- Common Drop :
  - Polytrim – wide spectrum, ↓ toxicity

- With ↓ response to treatment with Polytrim:
  - Fluoroquinolones

- Topical Antibiotic Therapy for 7- 10 days
# Ocular Medications & Children

## Anti-biotic Ointments

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>qid</td>
</tr>
<tr>
<td>Tobrex</td>
<td>qid</td>
</tr>
<tr>
<td>Ciloxan</td>
<td>tid x 2 days, bid x 5 days</td>
</tr>
<tr>
<td>Polysporin</td>
<td>qid</td>
</tr>
</tbody>
</table>
# Ocular Medications & Children

## Anti-biotic Drops

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polytrim</td>
<td>qid</td>
</tr>
<tr>
<td>Azasite</td>
<td>tid x 2days, qd x 5days</td>
</tr>
<tr>
<td>Besivance</td>
<td>tid</td>
</tr>
<tr>
<td>Ciloxan</td>
<td>1gtt q 2hrs x 2days, qid x 5 days</td>
</tr>
<tr>
<td>Ocuflox</td>
<td>1gtt q 2hrs x 2days, qid x 5 days</td>
</tr>
<tr>
<td>Quixin</td>
<td>1gtt q 2hrs x 2days, qid x 5 days</td>
</tr>
<tr>
<td>Vigamox</td>
<td>tid</td>
</tr>
<tr>
<td>Zymar</td>
<td>1gtt q 2hrs x 2days, qid x 5 days</td>
</tr>
<tr>
<td>Zymaxid</td>
<td>1gtt q 2hrs x 2days, qid x 5 days</td>
</tr>
</tbody>
</table>
## Ocular Medications & Children

### Anti-biotic Drops

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polytrim</td>
<td>qid</td>
</tr>
<tr>
<td>Azasite</td>
<td>tid x 2days, qd x 5days</td>
</tr>
<tr>
<td>Besivance</td>
<td>tid</td>
</tr>
<tr>
<td>Ciloxan</td>
<td>qid</td>
</tr>
<tr>
<td>Ocuflox</td>
<td>qid</td>
</tr>
<tr>
<td>Quixin</td>
<td>qid</td>
</tr>
<tr>
<td>Vigamox</td>
<td>tid</td>
</tr>
<tr>
<td>Zymar</td>
<td>qid</td>
</tr>
<tr>
<td>Zymaxid</td>
<td>qid</td>
</tr>
</tbody>
</table>
Anterior Segment Pathology

Chronic Blepharitis
Chronic Blepharitis

- May result in:
  - Chronic blepharoconjunctivitis
  - Recurrent chalazia
  - Loss of lashes / madarosis
  - Thickening of lid margins

- **Treatment**
  - Warm compress/massage/lid scrubs
  - Topical Anti-biotic (drop vs. ung)
  - Oral Antibiotic
  - Surgical Excision
Anterior Segment Pathology

*Nasolacrimal Duct Obstruction*
Nasolacrimal Duct Obstruction

- Clinical Characteristics
  - 5-6% of newborns
  - Constant tearing
  - Redness irritation of lids
  - **With secondary conjunctivitis
    - discharge
    - injection
    - swelling over innermost aspect of lower lid
    - pain
    - fever
Nasolacrimal Duct Obstruction Etiology and Anatomy

- Incomplete opening of lower end of the NLD along side of nose between inner canthus of eyelid and inferior turbinate of the nasal cavity
Nasolacrimal Duct Obstruction

**TREATMENT OPTIONS**

1) Warm compress / Hydrostatic Massage

2) Topical Antibiotic Drops

3) Probing
The Course of Nasolacrimal Duct Obstruction

1983 T. Otis Paul

55 infants diagnosed with NLDO prior to 3 month old

Percentage of Spontaneous Resolution by 1 year of age

3 months - 15%
6 months - 46%
12 months - 93%
4 week old AA male
- Right eye tearing since birth
- Red right eye with purulent discharge x 2 weeks

- **Anterior Segment Evaluation**
  - Erythema and Edema OD
  - Yellow-green discharge OD
  - (+) Tear lake OD >>>OS
  - 3 = fluorescein disappearance test
  - (-) corneal staining

- **Assessment / Plan**
  - NLDO with 2° Bacterial Conjunctivitis OD
  - Rx Polytrim qid OD x 1 week
  - Warm compress / Hydrostatic Massage qid
  - RTC 1 week
**NLDO Patient**

- **5 weeks old**
  - ↓ Lid edema and tear lake
  - No NaFl stain
  - 2-3 = fluorescein disappearance test
  - (+) mucous in tear film
    - Continue with previous treatment regimen. RTC 2 weeks

- **8 weeks old**
  - Mom notes tearing has decreased significantly
  - Minimal lid edema and injection
  - Minimal discharge
  - (+) tear lake OD
  - 2-3 = fluorescein disappearance test
    - ↓ Polytrim bid ↑ to qid if conjunctivitis worsens
    - Continue with warm compress / massage
    - **Add lids scrubs with baby shampoo**
**NLDO Patient**

- **12 weeks old**
  - Mild lid edema
  - (-) discharge
  - ↓ tearing OD > OS
  - 2 = fluorescein disappearance test
  - d/c Polytrim, restart if conjunctivitis recurs

- **4 month old AA male**
  - Tearing significantly improved
  - 1 = fluorescein disappearance test
  - Partial vs. Resolved NLDO
  - Restart Polytrim / return to clinic if conjunctivitis returns
Instructions

- **Warm Compress**
  - 5-10 minutes of continuous warmth
  - Options

- **Lacrimal Sac Massage**
  - Use index finger wrapped in clean, thin, cloth
  - Begin between infants eyebrow
  - Drag finger down towards affected side, closing lid simultaneously
  - Continue movement, pressing firmly into the canthus
  - Continue onto cheek
  - 10 strokes / tid
What are differentials for tearing in an infant?

- NLDO
- Conjunctivitis
- Corneal Abrasion / Foreign Body
- #1 = Congenital Glaucoma
Presentations of Pediatric Pathology

Congenital Glaucoma
Differential Dx of NLDO

- **Congenital Glaucoma**
  - **Incidence**
    - From 1/10,000-1/25,000 live birth
    - presents during first year of life
  - **Characteristics**
    - Unilateral / bilateral (2/3, usually asymmetric)
    - 2/3 males
    - Steamy cornea/edema
    - Photophobia
    - **Tearing / Epiphora**
    - ↑ corneal diameter
    - Axial elongation with myopia
    - Elevated IOP
Differential Dx of NLDO

**Characteristics**
- Unilateral / *bilateral* (2/3, usually asymmetric)
- 2/3 *males*
- *Steamy cornea/edema*
- *Photophobia*
- *Tearing / Epiphora*
- ↑*corneal diameter*
- *Axial elongation with myopia*
- *Elevated IOP*
Congenital Glaucoma

- **Etiology**
  - Membrane covering TM?
  - Anomalous high insertion of iris
    - Infant angle not adult like
      - Pale TM
      - Indistinct Schwalbe’s line
      - Flat peripheral iris
      - Iris processes to TM
    - Open angle
      - AC deeper in Cong Glaucoma than normal infant angle
Congenital Glaucoma

- **Examination**
  - **IOP**
    - Norm = 8-15 mm Hg
  - **Corneal Horizontal Diameter Measurement**
    - Norm = 9-10 mm infant, 11 mm by 1 year old
  - **Anterior Segment Evaluation**
  - **A scan**
    - Axial length norms
      - Newborn - approximately 16 mm
      - 18 months - 20.3 mm
      - 2-5 yr. Old - increase avg. 1.1 mm
      - 5-13 yr. old - increase of 1.3
  - **Rx determination**
  - **DFE**
    - Usually need EUA
      - Check IOP under light sedation/meds ↓ IOP
Nasal and Ocular Allergy

- 70-90% of allergic rhinitis patients have ocular allergy

- Allergic rhinoconjunctivitis
  - 25% of the population
  - 80-90% of all allergic disorders
Allergic Cascade

Degranulated Mast Cell

Nerves

Antigen

Other Mediators:
- Prostaglandins
- Tryptase
- Heparin

HISTAMINE

Endothelial Gaping + fluid leakage = SWELLING

BLOOD VESSEL

Vasodilation = REDNESS
- 5-10 min

Nerve Stimulation = ITCHING
- 3-5 min

BLOOD VESSEL
Treatment of Allergy Patient

- Identify / Remove antigen
- Reduce edema
- Reduce inflammation

- Topical Ocular Agent
  - Allergy medication
  - Steroid
  - Combination of the two

- Oral medication

- Referral to allergist
### Ocular Allergy Medications

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pataday</td>
<td>qd</td>
</tr>
<tr>
<td>Patanol</td>
<td>bid</td>
</tr>
<tr>
<td>Lastacaft</td>
<td>qd</td>
</tr>
<tr>
<td>Elestat</td>
<td>bid</td>
</tr>
<tr>
<td>Bepreve</td>
<td>bid</td>
</tr>
<tr>
<td>Zaditor</td>
<td>bid</td>
</tr>
<tr>
<td>Alrex</td>
<td>qid</td>
</tr>
</tbody>
</table>
Anterior Segment Pathology

Pediatric Red Eyes / Conjunctivitis

Vernal Keratoconjunctivitis
Vernal Keratoconjunctivitis

- Vision Threatening
- Chronic, bilateral conjunctival inflammatory disorder
- Male > Female
- Typically onset before 10 years of age, resolution by puberty
- Seen most in warm, dry, climates???
- Significant atopic history
Vernal Keratoconjunctivitis

- **Symptoms**
  - Pain
  - Itching (severe)
  - Conjunctival injection
  - Ptosis
  - Mucous discharge

- **Clinical Signs:**
  - Large papillae
  - Conjunctival hyperemia with edema
  - Horner-Trantas dots = clumps of eosinophils with dead epithelial cells
Summary of Pediatric Red Eyes

- Conjunctivitis
  - Bacterial
  - Viral
  - Allergic

- More severe
  - Preseptal cellulitis
  - Orbital cellulitis
Anterior Segment Pathology

Preseptal and Orbital Cellulitis
PRESEPTAL CELLULITIS

- **Definition** - infection of soft tissues of the eyelid and periocular region anterior to the orbital septum

- **Clinical Characteristics**
  - eyelid edema
  - erythema
  - warmth of eyelid
  - conjunctival chemosis / ocular discharge

- **NOT PRESENT**
  - proptosis
  - restriction of ocular motility
  - pain with eye movement
PRESEPTAL CELLULITIS

Possible Etiologies

- Chronic Blepharitis / conjunctivitis
- Internal Hordeolum
- Acute Dacryocystitis
- Penetrating Injury
- Bite Wounds
- Respiratory Infection
- Sinusitis
- Dermatitis
PRESEPTAL CELLULITIS

- **Differential Diagnosis**
  - Orbital Cellulitis ****
  - Allergic Lid Edema
  - Viral Conjunctivitis with Lid Edema
PRESEPTAL CELLULITIS

How to determine severity / treatment options:

- Is patient toxic?
- Is patient/parent non-compliant with treatment?
- Child < 5 years old
- No improvement within 3-4 days of administering oral anti-biotic
PRESEPTAL CELLULITIS

TREATMENT OPTIONS

Mild > 5 y.o.
ORAL ANTIBIOTICS

Moderate to Severe
Consult
Hospitalization
IV ANTIBIOTICS
Definition – infection of the soft tissues of the orbit posterior to the orbital septum

Clinical Characteristics

- unilateral orbital tenderness
- Pain on eye movement
- PARALYSIS of extraocular muscles
- Proptosis
- Papilloedema
- Blurred vision
- fever / systemic illness
ORBITAL CELLULITIS

- **Differential Diagnosis**
  - Preseptal Cellulitis

  - Differentiation made by:
    - Fever
    - Vision loss
    - Motility limitation
    - Proptosis
ORBITAL CELLULITIS

TREATMENT OPTIONS

CT Scan

IV ANTIBIOTICS
Cellulitis Case

- 5 yo AA female
  - Left eye swelling x 5 days
  - Given Augmentin (ER) – NI
  - Symptoms worsening
  - (+) injection, discharge and tenderness
  - (-) hx of trauma or allergies

- Examination Findings (ER)
  - VA = 20/20 OD, OS
  - 4+ lid edema OS
  - area of tenderness left upper brow
  - (+) injection and discharge
  - (-) cell / flare in AC
  - (-) proptosis
  - (-) EOM restriction,
  - (-) Pain on eye movement
Cellulitis Case

- **Assessment / Plan**
  - Likely Preseptal cellulitis
  - Ordered CT orbit / sinus (if abscess seen = admit)
  - Rx Zymar tid
  - Continue with Augmentin
  - RTC 1 day

- **One week follow-up**
  - Mom notes decreased edema and injection
  - Possible hordeolum in left UL
  - (+) UL edema
  - (+) conjunctival injection
  - (-) discharge
  - Continue with
  - Zymar tid
  - Augmentin (10 day cycle)
  - RTC 1 week
Cellulitis Case

Two-week Follow-up

- Elicit history of styes and allergies as per Mom
- (+) papillae and mild conjunctival chemosis
- Minimal injection
- Minimal lid edema
- D/C anti-biotic medications
- Rx Patanol prn for ocular allergies
- Rx Lid scrubs and warm compresses bid to aid in decreasing development of chronic hordeola
Presentations of Pediatric Pathology

Leukokoria
Leukokoria

- Must determine anatomic location of lesion

  - **Differential Diagnosis:**
    - Congenital Cataract
    - Retinoblastoma
    - Coat’s Disease
    - Retinopathy of Prematurity
    - Persistent Hyperplastic Primary Vitreous (PHPV)
Leukokoria

*Congenital Cataracts*
Leukokoria Differential Diagnosis

- Congenital Cataracts
  - 1/10,000, 400-500 infants per year
  - Risk of Image Degradation Amblyopia
Congenital Cataract

- **Treatment**
  - Cataract Extraction
    - IOL implant
  - Contact Lens Fit
  - Amblyopia Therapy

- **Contact Lens Fit**
  - May combine with spectacles
  - ↓ magnification
    - 20-30 % with specs
    - 8-12 % with contact lenses
  - Improves development, cosmesis
Leukokoria

- Must determine anatomic location of lesion

  - **Differential Diagnosis:**
    - Congenital Cataract
    - Retinoblastoma
    - Coat’s Disease
    - Retinopathy of Prematurity
    - Persistent Hyperplastic Primary Vitreous (PHPV)
Leukokoria

Coat’s Disease
**Coat’s Disease**

**Epidemiology**

- Exudative retinitis, retinal telangiectasis
  - Increased permeability of these abnormal retinal vessels causes leakage of the serum into intraretinal and subretinal spaces
- Inheritance pattern unknown
- Very rare; young males (M:F, 3:1)
- 80% unilateral
- Characterized by abnormal vessel development
- Poor prognosis in advanced stages
- Retinal detachment in advanced stages
Coats Disease

Stages

- I = abnormal dilation of retinal blood vessels
- II = telangiectasia and exudation
- III = exudative retinal detachment
- IV = total retinal detachment
- V = characterized by irreversible blindness
Coats Disease
Diagnosis

- CT Scan
  - the globe appears hyper dense compared to normal vitreous due to the exudate
Coats Disease

Treatment

- Ablation of causative lesions
- Laser photocoagulation or cryotherapy
- Steroid and anti-VEGF injections
- Enucleation
Leukokoria

Retinopathy of Prematurity (ROP)
Leukokoria Differential Diagnosis

**Retinopathy of Prematurity**

- A premature infant is an infant born before **37 weeks** gestation

- Prematurity used to be defined as any infant weighing less than **5.5 lbs**

- **ROP**
  - 40% of infants with birth weight ≥ 3 lbs
  - 50%-80% of neonates under ≤ 2 lbs
Retinopathy of Prematurity

- Retinal vascular disease secondary to premature birth, low birth weight, and use of supplemental oxygen

- Clinical severity can range from mild with no visual defects to aggressive with neovascularization, retinal detachment, and blindness.
Retinopathy of Prematurity

- **Pathophysiology**
  - Retinal vasculature begins at **16 weeks** gestation
  - Proliferation of capillaries will form the mature retinal vessels
  - The nasal portion of the retina becomes completely vascularized to the ora serrata by **32 weeks** gestation
  - The temporal portion is completed at **40-42 weeks** gestation
Retinopathy of Prematurity

- Defined in 5 stages

  - **Stage 1** – flat demarcation line between vascular and avascular tissue

  - **Stage 5** – total retinal detachment

    - Strabismus and high refractive error common
Retinopathy of Prematurity

- **Classification System**
  - 1) Location
    - Zones 1, 2, and 3
  - 2) Extent of Disease
    - Extent of disease based on clock hours
  - 3) Staging of the Disease
    - Severity of Disease into stages from 0 to 5
      - Stage 5 being most severe
Zones
Stage 1: Demarcation line

Stage 2: Ridge

Stage 3: Ridge with extraretinal fibrovascular proliferation

Stage 4: Retinal detachment

"Plus" disease (+)
Leukokoria Differentials

- Cataract
- Retinoblastoma
- Retinopathy of Prematurity
Posterior Segment Pathology

Optic Nerve Hypoplasia
Optic Nerve Hypoplasia

- Under development of Optic Nerve during pregnancy

- Causes: Unknown
  - Association with maternal DM, alcohol abuse, young maternal age, etc

- May be isolated as Optic Nerve issue or associated with neurological and hormonal abnormalities

- Wide spectrum of visual function and affect on VF
Optic Nerve Hypoplasia

Associated Conditions

- **Midline anomalies of brain**
  - Septo optic dysplasia (absence of septum pellucidum and corpus callosum)
  - Anomalies of ventricles
  - Cerebral atrophy
  - Tumors (rare)

- **Hormonal insufficiencies**
  - Thyroid
  - Growth hormone
  - Pituitary
  - Adrenal
  - anti-diuretic hormone (ADH)
Brother – bilateral optic nerve hypoplasia

OD -3.00-1.00 x 180  20/60
OS -1.00-1.50 x 180  20/25
Sister - unilateral optic nerve hypoplasia

pl -0.50 x 180  20/20

-5.25 sph  20/40
Common Presentations of Pediatric Pathology

Ocular Trauma
Ocular Trauma

- Most common cause of acquired blindness in children
- Boys 4x > vs girls
- Typically unilateral
- Cosmetic significance can be large
- Employment prospects are often reduced

Birth Trauma
- 25% all births
- 50% difficult births
- Most common
  - Chemical conjunctivitis (silver nitrate gtts)
  - Conjunctival hemes
Ocular Trauma

Types of Trauma

- **Eyelid trauma**

- **Subconjunctival hemorrhages**
  - May mask underlying penetrating or perforating injury

- **Corneal abrasions**
  - Typically patch children/cycloplegics

- **Eyewall Lacerations**
  - Monitor IOP
  - May need ultrasound if anterior segment heme or cataract is present

- **Non-accidental trauma**
Ocular Trauma

- **Non-accidental trauma**
  - Referral/collaboration with pediatrician
  - Full history/exam with photograph
  - Involvement of social services
  - Rule out other injury (X-ray, CT, MRI, etc)
Child Abuse

- 40% of abused children show ocular signs

- Be suspicious of frequent history of ocular/physical injury

- Types
  - Periorbital ecchymosis
  - Corneal abrasions
  - Lacerations
  - Hyphema
  - Angle recession
  - Cataracts
  - Dislocated lens
  - Retinal injuries
Ocular Trauma Case

- 11 year old AA male
  - Battery assault / hit by fists
  - Patient lying flat with collar / backbrace
  - (+) Pain, photophobia and blurred vision
  - VA
    - OD  20/100
    - OS  20/40
  - EOM  FROM OD, OS
  - Tonometry
    - OD  36
    - OS  17
  - Pupils: OD minimally reactive, (-) APD
Ocular Trauma Case

- **Anterior Segment Evaluation**
  - (+) hematoma
  - Blood in AC / Hyphema

- **Posterior Segment Evaluation**
  - C/D 0.2 rd OD, OS

- **Treatment**
  - Homatropine 1% bid OD
  - Timolol bid OD
  - Bed rest, elevated head to 30° - only restroom privileges
  - RTC 1 day
Ocular Trauma Case

- 11 year old AA male, One day follow-up
  - (+) Pain, photophobia
  - VA
    - OD 20/40
    - OS 20/25
  - (+) hematoma, right orbit, eyelid shut OD
  - 3 + AC cells
  - Hyphema
  - Mild corneal haze
  - 1+ injection of conjunctiva
  - Tonometry
    - OD 15
    - OS 11
  - **Traumatic Hyphema**
    - Pred Forte qid, Homatropine bid, Timolol bid
    - Bed rest, elevate head of bed 30 degrees, only restroom privileges
    - RTC 1 day
Ocular Trauma Case

- 11 year old AA male, Two day follow-up
  - VA
    - OD 20/60
    - OS 20/25
  - 3+ AC cells
  - Hyphema
  - 1+ injection of conjunctiva
  - Tonometry
    - OD 15
    - OS 11
  - C/D 0.2 OU, unremarkable DFE
  - Resolving Traumatic Hyphema
    - ↑ Pred Forte q 2 hours, Homatropine bid, Timolol bid
    - Strict bed rest
    - RTC 1 day
Ocular Trauma Case

- 11 year old AA male, Three day follow-up (9/21/05)
  - VA
    - OD 20/40  PH 20/40
    - OS 20/25
  - 2 + AC cells
  - Hyphema resolving
  - 1+ injection of conjunctiva
  - Tonometry
    - OD 10
    - OS 10
  - Resolving Traumatic Hyphema
    - Pred Forte qid, Homatropine bid, d/c Timolol
    - RTC 2 days
Ocular Trauma Case

- 11 year old AA male, Five days later (9/26/05)
  - VA 20/20 OD, OS
  - AC deep and quiet
  - Hyphema resolved
  - Lid edema OD
  - Tonometry
    - OD 15
    - OS 14
  - Resolving Traumatic Hyphema
    - d/c meds
    - RTC 1 week
Ocular Trauma

- **Hyphema in Childhood**
  - Rule out further intraocular damage
  - Rest!!!!
  - Watch the IOP
  - Avoid Aspirin / NSAID
  - Follow daily 1-2 wks (to ↓ risk of re-bleed)
  - Long Term must rule out:
    - angle recession (and eventual development of glaucoma)
    - dislocated lens
    - posterior segment damage
Blow-Out Fracture of Orbit

- Ethmoidal plate affected

- **Symptoms**
  - Pain / pain on eye movement
  - Loss of sensation of cheek
  - Diplopia
  - Blurred vision

- **Signs**
  - Ecchymosis
  - Ptosis
  - Limitation of ocular in upgaze

- Radiologic evaluation important
Summary

- Ocular Meds in Children
- Pediatric Examination techniques
- NLDO
- Congenital Glaucoma
- Conjunctivitis
- Preseptal / Orbital Cellulitis
- Leukokoria Differentials
- Ocular Trauma

- Use an “ocular emergency” visit for a child to educate the parent on the importance of early and regular optometric visits
QUESTIONS?

Contact:

Valerie M. Kattouf O.D.

vkattouf@ico.edu
(312) 949-7279