All About Red Caps: Mydriatics And Cycloplegics

Course Title:

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Please silence all mobile devices.
ALL ABOUT RED CAPS: MYDRIATICS AND CYCLOPLEGICS

ROYA ATTAR, OD, MBA, FAAO
PUPILLARY DILATION

Purpose:

➢ Improve visualization of the fundus
➢ Improve visualization increases detection rate of abnormalities
➢ Used for both diagnostic and therapeutic purposes
➢ The American Optometric Association’s 2015 evidence-based clinical practice guideline states that pharmacological dilation is generally required for the thorough evaluation of ocular structures
PUPILLARY DILATION

Indications:

• Routine examination on ALL patients
• For patients between the ages of 18 and 39, a comprehensive eye examination including ocular health evaluation is recommended at least every **two** years
• For patients age 65 and older, comprehensive eye examinations are recommended **annually in the absence** of a diagnosed ocular condition
PUPILLARY DILATION

Indications:

• More frequent monitoring with dilation is indicated in a patient with a previous diagnosis of ocular pathology

• Patients at higher risk of intraocular disease
  o Diabetic, high myopia

• Patients with symptoms or signs indicative of intraocular disease
  o Flashing lights (photopsia), floaters, and reduced visual acuity
PUPILLARY DILATION

Contraindications & Precautions

• Sensitivities to pharmacologic agents
  ➢ Phenylephrine: adrenergic supersensitivity
  ➢ Cyclopentolate: spastic paralysis and brain damage
  ➢ Sensitivity to preservative

• Narrow anterior chamber angle
  ➢ Consider prophylactic peripheral laser iridotomy prior to DFE if angle appears susceptible to closure on gonioscopy

• Presence of iris-fixed intraocular lens
  ➢ Risk of IOL dislocation with pupil dilation
Contraindications & Precautions

- **Documentation/preservation of pupil status**
  - Pupil status may serve as an important vital sign in patients with intracranial disease (coma evaluation)
  - Dilate with care in patients with recent history of head trauma
  - Unilateral pharmacologic mydriasis may masquerade as a sign of intracranial disease (Hutchinson’s pupil)
PUPILLARY DILATION

- **Mydriasis** = Dilation of the pupil
- **Mydriatics** = agent that induces dilation of the pupil
- Mydriatics aid in the examination of the vitreous, the retina, and the periphery
- **Cycloplegia** = paralysis of the ciliary muscle inhibiting accommodation
- Cycloplegics aid in a cycloplegic refraction and other therapeutic uses
Indications:

- Indications for use include:
  - Cycloplegic Refraction
  - Dilation for Ophthalmoscopy and Testing
  - Surgery
  - Suppression During Amblyopic Therapy
  - Palliative Care for Phthisis
  - Uveitis
Clinical Pearls:

- Using a local anesthetic before instillation of a mydriatic can facilitate the drug’s effect
  - The anesthetic decreases blinking and tearing and changes the permeability of the epithelium to the mydriatic agent
  - It also reduces any burning or stinging produced by instillation of the mydriatic
PUPILLARY DILATION

Topical Ocular Anesthetics

– Used to prevent eye pain during:
  • Diagnostic testing and procedures
  • Applanation tonometry
  • Gonioscopy
  • Ophthalmic examinations
  • Removal of foreign bodies or sutures
  • Surgery

Examples: Cocaine, tetracaine, benoxinate, proparacaine
TOPICAL OCULAR ANESTHETICS

Mechanism of Action:
- Blocks nerve conduction to superficial cornea and conjunctiva by disabling the ability of the nerve cells to generate an action potential
- Suppresses corneal and conjunctival sensitivity

Side Effects:
- Severe local reaction are rare, systemic reaction are even more uncommon

Ocular Toxicity:
- Mild stinging and burning
- Desquamation of corneal epithelium
- Retards epithelial healing
- Self medication increases risk of adverse effects
TOPICAL OCULAR ANESTHETICS

Contraindications & Precautions

➢ Self-administration
  – Risk of adverse effects due to corneal toxicity
  – Vision loss secondary to permanent scarring
➢ Hypersensitivity (Substitute different agent; little cross-sensitivity)
➢ Cultures
  – Toxic to microorganisms; Proparacaine least toxic
➢ Dry eye testing
  – Epithelial toxicity can confuse clinical picture
➢ Pachymetry
  – Transient corneal swelling following anesthetic use
➢ Perforating injuries
  – Endothelial toxicity
PUPILLARY DILATION

- Light color eyes dilate faster and more completely than do more darkly pigmented eyes, because there is less pigment in the iris to sequester the drug.
- Individuals with poorly controlled diabetes have smaller pupils and are slower to dilate than normal individuals.
- ↑ age = ↑ miotic pupils
- ↑ age = ↑ in latency time to dilate
- If pupils are dilated due to an abnormal response, they may remain dilated even in the presence of sunlight or strong light.
- Injury to the brain and intake of certain drugs are common causes of abnormally dilated pupils.
SIDE EFFECTS OF DILATION

Clinical considerations:

- Side effects of dilation
  - Blurred vision, especially for near tasks
  - Photophobia
  - Decreased ability to recognize low-contrast hazards
  - Increased glare sensitivity
  - May impair selected aspects of driving and vision performance
  - Can contribute to an angle-closure event in patients with narrow anterior chamber angles
  - Patients should be advised accordingly and given dilation glasses
  - Warn and Document
PRE-DILATION WORK-UP

• History
• Visual Acuity
• Pupil Reflexes
• Intraocular Pressure
• Anterior Chamber Angle
AUTONOMIC PATHWAY TO THE IRIS

Figure A: The sympathetic and parasympathetic tracts to the pupil pass through the cavernous sinus with relevant anatomical structures depicted. Note that the sympathetic pathway originates from the hypothalamus (not shown), while the parasympathetic pathway originates from the Edinger-Westphal nucleus in the midbrain.

Figure B: Pupillary responses to the sympathetic and parasympathetic signals. The sympathetic pathway induces pupil dilation via the dilator pupillae muscle. In contrast, the parasympathetic pathway induces pupil constriction via the sphincter pupillae muscle.
AUTONOMIC PATHWAY TO THE IRIS

- There are the two opposing muscles in the iris—the sphincter and the dilator—both of which are under the control of the autonomic nervous system.

- **Sympathetic pathway:** Hypothalamus → Ciliospinal center of Budge → Superior cervical ganglion → Dilator

- **Parasympathetic pathway:** Pretectal n. → E-W n. → Ciliary ganglion → Sphincter
Pupil constricts as circular muscles of iris contract (parasympathetic)

Pupil

Pupil dilates as radial muscles of iris contract (sympathetic)

Bright light

Normal light

Dim light

Anterior views
CHOLINERGIC DRUGS

Agonists (Parasympathomimetics)

- May be direct- or indirect-acting
- Causes iris sphincter contraction → miosis
- Causes ciliary body contraction → accommodation
- Example: Pilocarpine (green cap)
Antagonists (Anticholinergics)

- Binds to and inhibits cholinergic receptors
- Causes pupillary sphincter inhibition → mydriasis
- Causes ciliary body inhibition → cycloplegia
- Examples: Tropicamide, Cyclopentolate, Atropine (red cap)
- Useful acronym: STop ACH = Scopolamine, Tropicamide, Atropine, Cyclopentolate, Homatropine
Clinical considerations

- **Drug of choice** for routine mydriasis
- Fastest onset and shortest duration of action of mydriatic effects
- Equivalent mydriatic effect of 0.5% and 1%, greater cycloplegia with 1%

Side effects

- Stinging upon instillation
- Transient increase IOP in POAG patients

Contraindications and Precautions

- No reported adverse systemic effects
Clinical considerations

- Most potent mydriatic/cycloplegic currently available
- When complete cycloplegia is required

Clinical uses

- Refraction: Useful in cases of suspected accommodative esotropia; duration of action too long for routine refraction
- Amblyopia: Penalization of better seeing eye as alternative to occlusion
ATROPINE

Systemic Side Effects

• Safe when correct dosage is used – however, six reported cases of death in young children (under 3 years of age), most all of whom were sick and/or mentally delayed and had been given incorrect dosage

Precautions/Special Consideration

• Elderly patients
• Small children
• Down’s patients
Atropine Toxicity

Although rare, can elicit the following symptoms:

- Dry mouth (usually 1st sign)
- Dry flushed skin
- Rapid pulse
- Disorientation and fever due to CNS effects on the hypothalamus
Clinical considerations

- **Drug of choice** for routine cycloplegic refraction
- *Faster* cycloplegia with less residual accommodation
Clinical considerations

- Weak but prolonged cycloplegic effect and strong mydriatic effect make it suitable for *uveitis therapy*

- Standard for treating *anterior uveitis*
  - Useful in minimizing pain and for prevention of posterior synechiae
    - These benefits are obtained with minimal cycloplegic effects
      (unlike atropine)
SCOPOLAMINE

Clinical considerations
- Not routinely used; reserved for patients allergic to other agents

Contraindications & Side effects
- CNS effects more common because it more easily crosses blood-brain barrier

Precautions & Special Consideration
- Elderly patients
- Small children
- Down’s patients
**ANTICHOLINERGICS (PARASYMPATHOLYTICS)**

The efficacy and length of effect produced depends on each agent, as stronger agents tend to be longer acting.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Concentration</th>
<th>Peak</th>
<th>Recovery</th>
<th>Peak</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine (e.g., Atropisol and Isopto Atropine)</td>
<td>0.5–3%</td>
<td>30–40 min</td>
<td>7–12 days</td>
<td>60–180 min</td>
<td>6–12 days</td>
</tr>
<tr>
<td>Tropicamide (e.g., Mydriacyl and Tropicacyl)</td>
<td>0.5–1%</td>
<td>20–40 min</td>
<td>6 hr</td>
<td>20–35 min</td>
<td>6 hr</td>
</tr>
<tr>
<td>Homatropine (e.g., Isopto Homatropine and AK-Homatropine)</td>
<td>2–5%</td>
<td>40–60 min</td>
<td>1–3 days</td>
<td>30–60 min</td>
<td>1–3 days</td>
</tr>
<tr>
<td>Scopolamine (e.g., Isopto Hyoscine)</td>
<td>0.25%</td>
<td>20–30 min</td>
<td>3–7 days</td>
<td>30–60 min</td>
<td>3–7 days</td>
</tr>
<tr>
<td>Cyclopentolate (e.g., AK-Pentolate and Cyclogyl)</td>
<td>0.5–2%</td>
<td>30–60 min</td>
<td>1 day</td>
<td>25–75 min</td>
<td>8 hr</td>
</tr>
</tbody>
</table>
ADRENERGIC DRUGS

Direct alpha-adrenergic agonist

- MOA: Drug binds to and activates alpha-adrenergic receptors
- Causes stimulation of iris dilator muscle → mydriasis
- Example: Phenylephrine (red cap)
ADRENERGIC DRUGS

Indirect alpha-adrenergic agonist

- Two possible modes of action:
  - Release of stored norepinephrine
  - Inhibits reuptake of norepinephrine
- Mydriatic effect identical to direct-acting agents
- Example: Hydroxyamphetamine (red cap)
Clinical considerations

- Available in 2.5% and 10% solution
- The 10% strength produces an increase in rate but not magnitude of mydriasis
- 10% sol useful for breaking posterior synechiae
- Dilation without cycloplegia
- Often used in combination with anticholinergics to produce maximal dilation of the pupil
- 2.5% phenylephrine is used routinely in combination with tropicamide for routine dilation
- Duration of action
  - Max mydriasis: 45-60 min, Duration: 6-7 hrs
PHENYLEPHRINE

Contraindications & Precautions

- Risk of adverse cardiovascular events have been more frequently reported with the 10% strength, therefore 2.5% sol recommended for routine use
- Only 2.5% strength recommended in infants and the elderly
- Avoid phenylephrine in atropinized patients
- Limit 10% strength to 1gtt per hour per eye
- Use 10% strength with caution in patients with cardiac disease, orthostatic hypotension, hypertension, aneurysms, IDDM, advanced arteriosclerosis
- Contraindicated in patients taking MAO inhibitors, tricyclic antidepressants, reserpine, guanethidine, or methyldopa
PHENYLEPHRINE

Side effects

- Ocular: Mild stinging, pigmented aqueous floaters
- Systemic: Acute systemic hypertension, Ventricular arrhythmia, Tachycardia, Subarachnoid hemorrhage
  - Deaths following use of 10% topical phenylephrine have been reported
Clinical considerations
- Mydriatic effectiveness equivalent to phenylephrine
- Only available as 1% solution combined with 0.25% tropicamide (Paremyd)
- Role in localizing lesion in sympathetic paresis (Horner’s syndrome)

Contraindications & Precautions
- Same as for phenylephrine
- May, in theory, be safer than phenylephrine in high-risk patients

Side effects
- Less stinging than phenylephrine
- Little or no elevation of IOP in POAG patients
EYE DROP INSTILLATION

Goal: To deliver a full dose of the drug to the eye while minimizing systemic exposure and maximizing patient safety and comfort.

Preliminaries:

1. Patient education: explain purpose of the procedure
   **Inform the patient that you are going to instill drops that may cause temporary stinging**
2. Wash hands
3. Anesthesia: decreases patient discomfort and maximizes drug penetration through cornea
The preferred method for routine eye drop instillation (Solutions and Suspensions)

- Maximizes ocular contact time of drug
- Minimizes drug loss
- Increases ocular absorption
- Decreases systemic absorption
When administering ophthalmic solutions:
1. Tilt the patient’s head back so that it is almost horizontal
2. Instruct the patient to look up
3. Gently grasp the lower eyelid between your thumb and index finger and pull it away from the globe

**It is often necessary to hold the patient’s upper lid in addition to evert ing his lower lid. Then, it is appropriate to use one hand to hold the upper lid and the other hand to hold the bottle and to evert the lower lid.**
4. Check the container and **expiration** date. Shake the container and remove the cap.

5. Instill one drop of the solution inside the lower eyelid (inferior cul-de-sac).
   Hold the tip of the dropper clear of the sweep of the lashes about an inch (1-2 cm) above the pocket. **Avoid contamination of the eyedropper tip!**

6. Place the drop on the conjunctiva, not on the cornea.
   It may be useful to hold the eyelid for a few seconds after placing the drop in the cul-de-sac to allow the drop to settle. When releasing the lower lid, bring it upward until it touches the globe to minimize overflow.
7. After administration of the ophthalmic solution, instruct the patient to close his or her eyes gently for about 3 min.
8. Instruct the patient to gently apply gentle pressure to the puncta to prevent drainage and minimize systemic absorption.

*The patient should avoid closing the eyes tightly so the drug will not be expelled.
EYE DROP INSTILLATION

Recording:
- Record the name of the pharmaceutical agent used including its concentration, how many drops were instilled into each eye, and the time of day

Example:
- One drop (1gt) of 0.5% Proparacaine OD & OS @ 11:35 AM
- Dilation: 1gt of 1% tropicamide and 1gt of 2.5% phenylephrine OD, OS @ 11:40 AM
OTHER METHODS OF DELIVERY

Alternatives to the instillation of eyedrops:

➢ Medial Canthus Delivery
➢ Spray Bottle
➢ Pledgets
MEDIAL CANTHUS DELIVERY

A lower anxiety technique for persons unable to cooperate with inferior fornix delivery

Technique:
1. Head inclined backwards
2. Eyelids closed
3. Eye drops placed on top of medial canthus
4. Patient instructed to blink repetitively
Another lower anxiety technique

**Technique:**
- Mist applied to closed lids with spray bottle and the patient be instructed to blink
- Excess solution should be wiped off
- A second spray might be necessary, especially if the eyes were closed too tightly
Advantages:

• Efficacy reported to be equivalent as ophthalmic drops and more tolerable

• Patients were more compliant and experienced less burning when the spray was used than when ophthalmic drops were used
Disadvantages:

• Inability to deliver precise dosing
• Lack of an established dose–response relationship for this type of administration
• Potential for drug contamination,
• Most ophthalmic medications are not currently formulated for this type of application

*More studies are needed to determine dosing, frequency, and potential adverse effects associated with this method
PLEDGETS

Another lower anxiety technique

**Technique:**

– Cotton swab saturated with drug solution then placed in eye
– Permits very long or very short contact time
– Useful for inferior sector dilation, breaking synechiae
DRUG USE IN PREGNANCY

The A, B, C, D and X risk categories:

**Category A:** Adequate and well-controlled studies have failed to demonstrate a risk to the fetus in the first trimester of pregnancy (and there is no evidence of risk in later trimesters).

**Category B:** Animal reproduction studies have failed to demonstrate a risk to the fetus and there are no adequate and well-controlled studies in pregnant women.

**Category C:** Animal reproduction studies have shown an adverse effect on the fetus and there are no adequate and well-controlled studies in humans, *but potential benefits may warrant use of the drug in pregnant women despite potential risks.*

**Category D:** There is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience or studies in humans, *but potential benefits may warrant use of the drug in pregnant women despite potential risks.*

**Category X:** Studies in animals or humans have demonstrated fetal abnormalities and/or there is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience, and the risks involved in use of the drug in pregnant women clearly outweigh potential benefits.