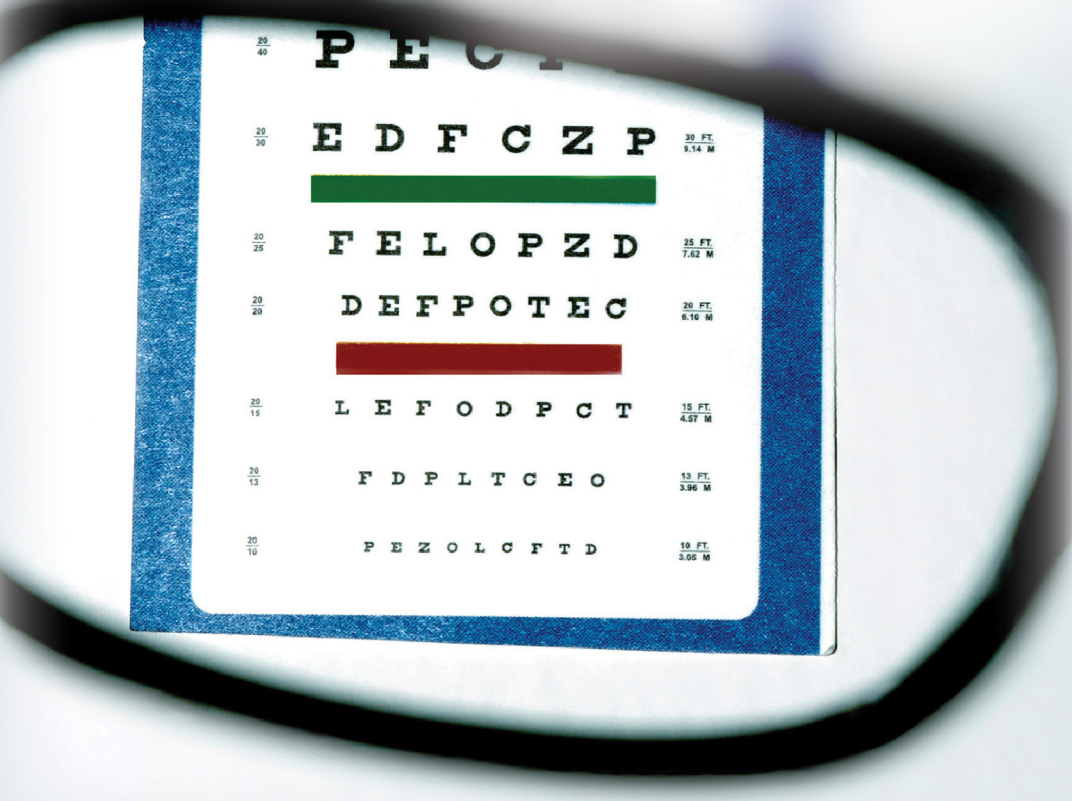
JAYPEE

Management of Refractive Errors & Prescription of Spectacles



Yogesh Shukla

Contents

2

Cycloplegia

INTRODUCTION

Cycloplegia, though thought by many clinicians, to be used only out of necessity, is one of the vital ingredients for solving many clinical problems. It is not a medicine to be put in a side-table drawer, and used sparingly. Actually, it is one of the most required diagnostic tools which must be used judiciously to enable us to learn more about refractive conditions than is evident by manifest refraction alone.

To be more emphatic, cycloplegia is mandatory in refracting children and young adults even up to the age of 21 years! In my practice, cycloplegic refraction is performed routinely each time when a young patient comes for the first time and for yearly follow-up visits. You will be surprised, how often a hyperopia or hyperopic astigmatism is uncovered. Remember this pearl: Any patient who complains of headache or other symptoms of ocular asthenopia, irrespective of his vision, must undergo cycloplegic refraction. You might be amazed to know that such patients have already gone from pillar to post, visited all related specialties, but headaches have persisted. And then, wisdom prevailed in some doctor, the patient was referred and a good cycloplegic refraction exposed his

refractive error, mostly hyperopia and/or astigmatism. And a simple spectacle correction alleviated all his problems. The more you learn from cycloplegia, the more you benefit the patient and will be overwhelmed to find that such a simple procedure produces such satisfying results for the patients.

Let us now delve into the pharmacogenics of cycloplegia.

An ideal cycloplegic drug should possess the following characteristics:

- Rapid onset of cycloplegia.
- Maximum relaxation of accommodation.
- Short duration of action.
- No residual side effects.
- No toxic effects—locally or systemically.

Till date, whatever drugs we have in our basket, none have the entire above characteristics.

A cycloplegic drug is then chosen, depending on the age, the degree of iris pigmentation, the type of refractive error discovered on manifest refraction, local condition of eye, especially the angle depth, and any neurogenic disorder, e.g. epilepsy. Further, the dosage and concentration has also to be titrated according to the patient. It is to be remembered that all cycloplegic drugs produce mydriasis also. But a primarily mydriatic drug does not produce cycloplegia, e.g. neosynephrine or eucatropine, very little cycloplegia.

A cycloplegic agent is used in the eye for following conditions:

- To aid in refraction.
- Paralyze iris and ciliary body postoperatively.
- Relieve ciliary spasm.
- Break iris synechiae.
- To treat anterior uveitis.

As an indispensible aid in refractions, it should be used in the following conditions:

- In all children, up to 12 years of age, as a mandatory procedure.
- Manifest refraction not compatible with vision, up to 21 years of age.
- Whenever refraction yields variable results, at any age.
- Symptoms relating to ocular asthenopia, irrespective of vision.
- Suspected extraocular muscle imbalance.

- Whenever patient's complaints are disproportionate to the manifest refraction. A myope with frontal headaches—may be overcorrected or headaches in moderate hyperope—may be undercorrected.
- Early presbyopia, especially when glasses have never been worn.
- In infants and young children, where vision is difficult to assess.
- In bedridden or mentally challenged patients.
- In suspected or actual ciliary spasm.
- In gross anisometropia or antimetropia.

CONTRAINDICATIONS

In the following, cycloplegia should be avoided or used with caution:

- Without or absence of patient's consent.
- History of drug reactions, like a previous episode in young child with atropine.
- History of angle closure attacks.
- Critically narrow angles. Here, if necessary, a short-acting cycloplegic can be used, with informed consent that angle closure attack may be precipitated.

SOME SPECIAL SITUATIONS

- Occasionally you may face a situation, where you think that a cycloplegic examination is a must, but the patient expresses inability for a return visit. It is prudent not to fall prey to a manifest refraction only and prescribe spectacles. The patients may be politely advised to return according to his convenience for a cycloplegic refraction and a postcycloplegic test. Or you can suggest a cycloplegic refraction now and a postcycloplegic final prescription, at his convenient clinic (provided the other clinician is conversant with what you intend!). In cases, if you find that the cycloplegic refraction does not differ much from the manifest, and you can assure the patient that he need not take a second visit any place, then a final prescription can be written.
- Another similar situation where the patient is unable to return for a postcycloplegic check.

The following example will obviate your anxiety:

A young man visits clinic with complaints of headaches on reading and expresses inability to return next day as he is leaving for abroad next morning and insists on examination as this will bother him in a foreign city. The manifest refraction yields +0.75 D OU and Prince ruler, full amplitude.

This small amount of hyperopia should raise suspicion as to probable more hyperopia which the patient is compensating by excessive accommodation. Cycloplegic refraction yields OU +3.0 D hyperopia! The fort has been conquered. But only half! What should be done now as the person will not come for final prescription. Post-cycloplegic test in these cases is important, as full correction may not be tolerated and will cause blurring in distance. Here it will be wise to give half correction, e.g. +1.5 D and for reading only, as this is what is causing his main problem; and the patient may be explained about his error. He will remain symptom free, till his next visit few years later.

QUALITIES OF A CYCLOPLEGIC DRUG

Effectiveness

The purpose of cycloplegic refraction is to eliminate the variability created by an unpredictable accommodation. The most effective drug, therefore should completely suppress accommodation. But unfortunately most drugs do not. Some residual accommodation is still left behind. This residual accommodation depends upon again the age of the patient, the degree of refractive error, the dosage and the concentration of drug, the iris color, etc.

It is always wise to know the residual accommodation by a Prince ruler, prior to performing cycloplegic refraction. In young patients, below 30 years age, a residual amplitude of less than 2 D, can be considered acceptable; between 30 years and 40 years +1.5 D and above 40 years, no more than 1.0 D is acceptable. If the residual accommodation is beyond the above limits, then the dosage is to be increased or a stronger cycloplegic should be instilled.

Table 2.1 illustrates the drug of choice, dosage, concentration, mechanism of action, duration, etc. for firsthand knowledge.

Recommended Dosage (Table 2.1)

There is a considerable overlap in the choice of drug to be used in a particular patient. There does exist rule-of-the-thumb, but the type of drug to be used depends upon the indications given above, upon the presenting condition and clinical experience of the physician. Broadly speaking, atropine is the drug of choice in an infant and toddler; but here again the concentration varies and the type of delivery. Atropine ointment is preferred below age 1 year, as its systemic absorption in slow. Drops can be instilled between 1 year and 3 years. Homatropine 2% is preferred between 3 years and 5 years age. But in a child of 8 years with strabismus, atropine will be preferred whereas under other conditions cyclopentolate 1% or 2% is instilled between 5 years and 12 years. Over 12 years, tropicamide 1–2% suffices in most instances.

As a rule, lesser cycloplegic agent is preferred for children with normal vision and stronger for children with reduced vision or muscle imbalance.

Though only specified concentration and dosage should be used, taking into account the age and suitability of patient, but many times the desired effect is not produced (This is very easily determined as the patient's near vision still remains clear.) In such situations, there is a tendency by the clinician to instill some more drops. This practice is to be discouraged, as more instillations may exceed the safe dosage and liable to induce toxic effects. The patient may be called another time and a stronger cycloplegic agent used.

Duration of Action

Each cycloplegic agent has a different duration of action. Though most of the cycloplegic agents have a known duration of effect but there have been reported cases of effect of cyclopentolate 1% lasting over 4 weeks. Patients should be warned of such untoward action of drugs, especially for stronger agents like atropine and homatropine. If the patient feels alarmed or anxiety overrides his common sense, then the patient may be called and a drop of 1% pilocarpine instilled. This may help in cases where tropicamide or cyclopentolate is used but will not be effective for atropine or homatropine. The effect of pilocarpine may wane off before the effect of cycloplegia, and the

TABLE 2.1 Characteristics and dosages of cycloplegic agents

Cycloplegic drug	*Pharmacologic action*	*Concentration*	*Age range*	*Dosage*	*Maximum cycloplegic effect*	*Duration of mydriasis*	*Duration of cycloplegia*
Atropine sulfate ointment	Parasympatholytic	0.5 and 1%	Below 1 year	TDS for 3 days	1–3 days	10–12 days	15 days
Atropine sulfate solution	Para sympatholytic	0.5–1.0%	1 to 3 years	1 drop TDS for 3 days	1–2 days	10–12 days	15 days
Homatropine hydrobromide solution	Parasympatholytic	2%	3–21 years	2 drops 10 minutes apart	60 minutes	24–36 hours	24–36 hours
Scopolamine (solution or ointment)	Parasympatholytic	0.25%	3–10 years	2 drops 10 minutes apart	60 minutes	2–3 days	3–5 days
Cyclopentolate solution	Parasympatholytic	0.5%, 1% and 2%	Above 25 years 3–21 years	2 drops No repeat	45 minutes	16–24 hours	16–24 hours
Tropicamide solution	Parasympatholytic	1% 2%	21 years above 12 years above	2 drops 5 minutes apart	30–45 minutes	6–12 hours	6–12 hours

blurriness might return. Sometimes, only mydriasis may wear off but cycloplegia may persist. At best, it is always prudent to explain to the patient the consequences of the effect of such drugs and alleviate his fears. A good idea is to have patient wear dark goggles when going outdoors as this may give some respite from glare and permit at least some activity outdoors.

Side Effects

As we know all cycloplegics produce mydriasis also. Thus, photophobia and glare are normal side effects. This has to be notified to the patient before a cycloplegic is instilled and also the duration of action of each drug. This discomfort can be minimized by advising the patients to wear dark goggles in daylight, till the effects wanes.

Serious side effects are not common and for the most part, are dose-related. In any case, the dosage and concentration must never be exceeded. Before instillation of a cycloplegic, the age, iris color, presumed type of error, history of any previous untoward action must be taken into consideration. If the cycloplegic effect has not occurred with a particular agent, another drug should be tried later or some more time given to have the full effect, rather than instilling more drops. Atropine is known to cause maximum side effects. In children, even normal doses can cause serious side effects. Idiosyncrasy to atropine can cause alarming side effects and toxicity, but commonly they result from excessive systemic absorption. Marked flushing of face, dryness of mouth, hot dry skin, fever, restlessness, rapid pulse, can all occur. The following hard fact will surprise the reader. A 1% atropine sulfate solution contains 10 mg of atropine per mL; there are about 10 drops in one mL (milliliter). The instillation of one drop in each conjunctival sac will yield a dosage of 2 mg (1.0 mg each) of atropine. This is about four times the usual adult parenteral dose!

Extreme toxicity can occur in idiosyncrasy or in hypersensitive individuals, such as Down's syndrome, and can result in hallucinations, convulsions, delirium, coma and even death. Locally atropine can cause induration and dermatitis over lids and cheeks and conjunctival congestion. Homatropine and cyclopentolate are relatively safer but in young children, care should be observed regarding dosage and fair skin. Cyclopentolate 1% is known to cause

restlessness, disorientation and delirium. These central nervous system side effects are pronounced in very young children, especially with history of epilepsy or related disorders. All water-soluble cycloplegic drugs are absorbed through conjunctiva, lacrimal and nasal mucosa. An aqueous preparation placed in conjunctival sac, will appear in the nose within one minute.

In order to decrease the systemic side-effects, atropine can be used as an ointment which lessens the systemic absorption. In case of drops, the medial canthus can be kept pressed for a minute or two, to prevent the drug entering the lacrimal sac and nasal mucosa.

Treatment

Local skin and conjunctival reactions are best treated by discontinuing the drug. Fever and flushing can be managed by cold sponging and antipyretics.

Serious side effects or toxicity may require hospitalization particularly in children.

CYCLOPLEGIA AND GLAUCOMA

It cannot be overemphasized that strong cycloplegics are not to be used in a patient with possibility of angle closure. Whenever it becomes a necessity to use cycloplegics, as a general rule, the following ground rules should be followed:

- Make an informed consent regarding the reasons and added risk of using cycloplegia. Also, the patient may be kept in the clinic for some hours, to immediately institute corrective measures
- Use a mild agent like cyclopentolate 0.5% or tropicamide 0.5%
- If a miotic has been used to counter the mydriasis, then keep the patient in clinic, till mydriatic effect has subsided. This is to ensure that miosis itself may not trigger an angle closure attack, a significant clinical point to be kept in mind in refractions done in patients suffering from glaucoma.

In case where patients with narrow angles are kept on miotic therapy as a preventive measure from angle closure attack, the refraction will vary significantly if a mild cycloplegia is used in their case; miotics increase the tone of ciliary muscles and thus

accommodation. Such patients may show variable refractions during miosis and after cycloplegia. If the patient is to be kept for long on miotic therapy (where laser peripheral iridotomy is not done), then it is advisable to have the refraction done under miotic conditions.

Open angle glaucoma itself is known to causes changes in refraction. This change is compounded, when glaucoma therapy changes with time. But since cycloplegic agents are safe in this type of glaucoma, it is prudent to use a cycloplegic for refraction.

CLINICAL PEARLS

A pertinent question always haunts the clinician, as what prescription to be given after a cycloplegic refraction. Have the patients to be always called for a postcycloplegic examination?

The answer is as elusive as the question. Following are the cases where postcycloplegic test in indicated:

Children

Children under 18 or 21 years, who show hyperopia but are asymptomatic will not require any glasses and need not come for a second visit.

Myopes will have the same error after cycloplegic refraction and will not show any discrepancy in a postcycloplegic test and therefore, do not need another visit. But children showing astigmatism, anisometropia or demonstrating symptoms, need a postcycloplegic exam. Children with mixed astigmatism require special attention during a postcycloplegic test.

Adults

These are a major group manifesting ocular asthenopic symptoms. Here manifest refraction may not yield any refraction error or may yield variable error. Cycloplegic refraction now yields hyperopia or astigmatism. Such patients require a postcycloplegic test for acceptance. Patients whose manifest and cycloplegic refraction yield compatible data, prescription can be safely given and postcycloplegic test is not needed.

There is another group in the presbyopic or prepresbyopic age. If the manifest and cycloplegic refraction are same, then prescription is promptly given. But where a significant difference appears in the two refractions, a postcycloplegic test is warranted. Cycloplegic refraction after 50 years of age is rarely needed.

SUMMARY

- Cycloplegia must be used judiciously and kept as an essential tool in the arena of examination.
- The type of cycloplegic should be not indiscriminately chosen and indiscriminately used. Selection should be done depending upon the age of patient, type of error, symptoms of patient, iris color, any systemic anomaly, local anomaly in eye, etc.
- Patients should be informed (consent taken verbally may suffise) regarding the effect of cycloplegia and its side effects.
- Postcycloplegic test should be taken seriously, as you may find a great difference in the cycloplegic refraction and what the patient accepts.
- Never, in any circumstances, refract a child below 12 years without cycloplegia. And a young person, who has symptoms of ocular asthenopia.

Management of

Refractive Errors & Prescription of Spectacles

This book has emerged from long years of arduous, painstaking, and sincere clinical research. It is also an essence of endurance of the plight, pains, and pitfalls faced by persons who suffer from refractive errors.

Refractive errors are probably the most common and simple ocular ailments prevailing in the general population. But, unfortunately, they are taken most casually and callously. A large proportion of visually handicapped persons are a result of improper management of their refractive errors; and mental agony due to miscued spectacle prescriptions and manufacturing. Therefore, the book clarifies lots of misconceptions regarding this simple but very important subject. This book is dedicated to the millions of children and adults who lost their educational opportunities and suffered from severe social and economic consequences due to inappropriate management of their refractive errors and optical corrections.

Yogesh Shukla is Professor, Ophthalmology, National Institute of Medical Sciences, Jaipur, Rajasthan, India. He has almost 30 years of clinical and teaching experience. He has done Fellowship in Anterior Segment, Eye Foundation of America, West Virginia, USA; and Fellowship in Pediatric Ophthalmology and Strabismus, Johns Hopkins University Hospital, USA. He has been regularly giving lectures as an Invited Faculty in International Conferences and held Instruction Courses in All-India Conferences for a number of years on eye problems in children. He has been the President, Rajasthan State Society; Executive Member, Academic and Research Council, All India Ophthalmology Society (AIOS); Past Secretary, Ocular Trauma Society of India; Member, Indo-US Advisory Committee on Prevention of Childhood Blindness; and General Secretary, Strabismus and Pediatric Ophthalmological Society of India.

Available at all medical bookstores
or buy online at www.jaypeebrothers.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
OPHTHALMOLOGY

ISBN 978-93-5152-884-5