

Ocular Pharmacology of Femtosecond Laser Cataract Surgery

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Pharmacology of femtolaser cataract surgery has an important role because ophthalmic drugs are administered as topical drops or eye ointments prior to femtolaser pretreatment. The pupil should be at least 6.0-mm wide prior to femtolaser surgery, and this pupil size should be maintained during the cataract surgery also. A well-dilated pupil renders surgery much easier and promises less surgical complications. Proper pupil size is of the utmost importance in traditional phacoemulsification also. During femtolaser pretreatment, if the pupil is not widened enough the laser may hit the iris, causing a significant rise in prostaglandin E2 and other kinds of cytokine levels in the aqueous humor. In 1989, Gimbel reported the beneficial effect of nonsteroid anti-inflammatory drug (NSAID) drops in keeping the pupil dilated during phacoemulsification.¹ Bucci and Waterbury reported a rise in prostaglandin E2 level.² In 2013, Schultz et al reported a statistically significant increase in prostaglandin E2 level following femtolaser pretreatment.³ Therefore, preoperative pupillary pharmacology has an important role in achieving all the benefits of femtolaser surgery for both the patient and the surgeon.

ANATOMY OF PUPIL REACTIONS

The sphincter muscle of the iris runs in a circle around the pupil; when in action the pupil narrows (miosis). The radial fibers of the dilatator muscle enlarge the pupil; this is called mydriasis.

It is important that parasympathetic fibers innervate the sphincter muscle. They come from the Edinger-Westphal nucleus of the oculomotor nuclei and reach the sphincter muscle via the oculomotor nerve (lower branches of the III nerve) first, then the ciliary ganglion, and then the iris.

The sympathetic fibers of the dilatator muscle come from the cervical chain via the carotid artery and the nasociliary nerve.

The pupillary reaction to light and darkness is elicited by the pupillomotor fibers of the retina. Light impulses

from the retina are transmitted up toward the pretectal nuclei and from there the oculomotor nuclei are reached.

Miosis can be caused pharmacologically by parasympathomimetic drugs. Mydriasis can be achieved by sympathomimetic drugs and also by parasympatholytic agents (mydriatic drops).

Usually topical tropicamide (0.8%) and phenylephrine (5%) are administered either separately or in combination prior to the start of femtolaser treatment.

With traditional phacoemulsification, pharmacological pupil dilation is started 1 hour before surgery, in combination of the above-mentioned drops, and the patient receives drops every 20 minutes. In femtosecond laser-assisted cataract surgery, pupil dilation should start earlier, at least 1.5 hours before surgery, and NSAID drops also should be added to the preoperative regimen.

THE MOST COMMONLY USED SUBSTANCES DURING CATARACT SURGERY

- ▶ **Parasympatholytics:** act by blocking acetylcholine receptors of the sphincter pupillae (mydriasis) and the ciliary muscle (accommodation paralysis)
 - **Tropicamide:** effective for approximately 4 to 6 hours
 - **Cyclopentolate:** effective for 12 to 24 hours, more cycloplegic than mydriatic effect
 - **Homatropine:** effective for 1 to 2 days
 - **Atropine:** effective for less than 1 week (longest-acting mydriatic), not used routinely in cataract surgery
- ▶ **Sympathomimetics:** act on adrenaline receptors of the dilatator pupillae muscle
 - **Phenylephrine:** effective for 6 hours, onset and duration of action identical to tropicamide; advantage: does not cause accommodation paralysis
 - **Cocaine (4%):** indirect sympathomimetics, inhibits reabsorption of norepinephrine (not used routinely anymore), effective for 6 hours, today used only in diagnostics of Horner syndrome