Mydriatic strategies for cataract surgery: optimizing efficacy and cost

William J. Dupps Jr, MD, PhD
Cleveland, Ohio

Cataract surgery is consistently among the most commonly performed surgeries in the world, and dilation of the pupil is a requirement in every case. A poorly dilated pupil greatly compounds the difficulty of surgery. Visualization of the capsulorhexis is impeded, making proper sizing and centration of the rhexis difficult. Unintended enlargement of the rhexis can occur and can compromise intraocular lens (IOL) centration and toric IOL rotational stability. Radialization of the capsulorhexis is more likely, and extension of tears into the posterior capsule can occur that limit the ability to place the intended IOL in the bag. Even if the capsulorhexis is successfully completed, subsequent steps of the surgery are complicated by a reduction in direct visualization of the peripheral nucleus and cortex and loss of intensity of the indirect red reflex illumination that provides crucial visual feedback for grooving the nucleus, ensuring complete removal of cortical material during cortical stripping, and monitoring the posterior capsule during capsular polishing and IOL insertion. A small pupil requires additional iris manipulation to visually confirm proper alignment of the intended axis, and for femtosecond laser–assisted cataract surgery, a small pupil can make laser-assisted capsulorhexis and nuclear fragmentation impossible without additional mechanical aids.

It follows, then, that poor mydriasis carries a much higher risk of intraoperative and postoperative complications. These include damage to the iris from prolapse or other trauma, which can result in iris stromal defects, pupillary sphincter dysfunction, or iridodialysis. Other complications such as posterior capsular rupture, vitreous loss, retained nucleus or cortex, cystoid macular edema, and retinal detachment can occur. Although comorbid conditions such as pseudoexfoliation syndrome, diabetes mellitus, and alpha adrenergic receptor agonist use tend to hamper dilation, even small differences in mydriasis in eyes without a predisposition to poor dilation affect visualization because of the second-order relationship between pupil radius and visible aperture area (πr^2). Even in the absence of complications, the technical difficulties carry a cost: increased surgical time, additional expense for mydriatic devices or additional intracameral pharmacological agents, more pain or anxiety for the patient, and more stress for the surgeon, whose schedule is developed around the assumption of short cases and low room turnover times.

The question of mydriatic efficacy of various options for perioperative dilation is, therefore, of great practical interest to cataract surgeons. Preoperative options include traditional combinations of drops (phenylephrine hydrochloride 2.5% or 10%, tropicamide 0.5%, and cyclopentolate hydrochloride 1%) and a fornix insert delivering 5.4 mg phenylephrine hydrochloride and 0.28 mg tropicamide (Mydriasert, Thea Pharmaceuticals), both of which require administration 30 to 60 minutes prior to surgery. Intracameral agents, including a commercially available tropicamide 0.02%, phenylephrine hydrochloride 0.31%, and lidocaine hydrochloride 1% mixture approved for use in the European market (Mydrane, Thea Pharmaceuticals), offer the advantage of eliminating preoperative drop administration. A recent Cochrane review by Iftikhar et al. found that topical drops produced larger pupil diameters than intracameral mydriatics in 4 randomized controlled trials (RCTs) at the time of capsulorhexis but rated the certainty of this finding low after downgrading based on risk for bias and imprecision.1 A comparison of topical and depot delivery mydriatics in the same report found no evidence of a difference in pupil size at the beginning of cataract surgery (size at capsulorhexis was not reported in any of the 7 RCTs), and neither comparison supported a significant effect on operative time. Unsurprisingly, combined preoperative and intraoperative time was significantly reduced by intracameral mydriasis as reported by Labetoulle et al., who also demonstrated a higher number of patients with ocular discomfort at 1 week and 1 month postoperatively in the topical group.2 None of the reviewed studies compared costs.

Given scant evidence for superiority in dilation efficacy among these approaches, cost assumes even greater importance as a differentiator. In this issue, Simons et al. (page 982) took an important step toward addressing the cost assessment gap with their prospective study of topical, intracameral, and ocular insert mydriatics in 368 patients undergoing cataract surgery at a single hospital in the Netherlands. Their standard topical mydriatic practice was a maxed-out triple cocktail containing phenylephrine 10%, tropicamide, and cyclopentolate, and the comparison groups used the commercially available insert and intracameral (ICMA) mydriatics described earlier. Incremental cost was the primary outcome measure and included the
mydriatic agents, additional materials to administer the ICMA, operating room time, additional intraoperative mydriatics (including devices), nurse time spent on mydriatic administration, and postoperative care related to pain. Secondary outcomes included pupil size measured at key times from surgical video, surgeon-reported satisfaction, and patient-reported outcomes by 2 questionnaires.

In this study, intracameral mydriatic was associated with a higher incremental cost, and topical mydriatics were the least costly strategy. Although ICMA decreased preoperative nursing costs and time, it was associated with a longer mean surgical time that offset this advantage. It is important to note that no changes in the preoperative routine that could have leveraged the shorter preoperative stay were implemented in the comparison. This likely explains a discrepancy with a recent study that showed efficiency gains in operative time and rotation time between patients with ICMA. Importantly, the increased operative times and smaller pupil diameters noted with ICMA in the study by Simons et al. may have contributed to lower surgeon satisfaction scores in the ICMA group than those in the topical and insert groups.

Although costs will vary significantly across practices, this study provides important new information relevant to both the efficacy and cost of options for mydriasis prior to cataract surgery. It is valuable to have options such as ICMA and inserts that have been shown to reduce systemic absorption for patients who may be predisposed to systemic side effects, and these options also carry less risk for corneal epithelial toxicity and associated symptoms compared with topical drops. Some hospitals, including mine, compound their own topical mydriatic solutions in a single syringe. Although perhaps not accessible in all practice settings, this has greatly reduced our cost of opening, administering, and then disposing of 3 separate commercial bottles of mydriatics and could further increase the advantage of the topical approach observed by Simons et al.

REFERENCES

First author:
William J. Dupps Jr, MD, PhD
Cole Eye Institute, Cleveland Clinic, Cleveland, Ohio