Cataracts affect more than 24 million people in the United States, and 3.5 million cataract surgeries are performed in this country annually.\(^1\) As the number of patients needing cataract surgery continues to climb, the preoperative measurements, the surgical procedure and its precision, and the range of refractive lens options available continue to evolve. With all of these advances serving to decrease the invasiveness and increase the accuracy of cataract surgery, one of the biggest concerns that remains for patients is the arduous process of using postoperative eye drops. Similarly, for clinicians, one of the biggest postoperative concerns is drop compliance issues. Patients’ lack of adherence to their medication regimens can lead to complications, the most devastating being endophthalmitis. Endophthalmitis rates in the range of 0.04% to 0.2% have been reported after cataract surgery, and these numbers have been decreasing since a spike in the late 1990s into early 2000s.\(^2\)

There are exciting recent advances in drug delivery that can help to increase compliance while at the same time decreasing the number and costs of postoperative drops and the incidence of endophthalmitis. These technologies range from combining multiple drugs into one drop, to the use of medicated punctal plugs, to intracameral or intravitreal injections at the end of surgery.

**COMBINATION DROPS**

The growing list of LessDrops formulations (Imprimis Pharmaceuticals) combine mixtures of prednisolone, moxifloxacin, ketorolac, and triamcinolone in one bottle.\(^3\) Coupling medications in this manner cuts the number of drops patients have to keep track of by at least half. In addition, with LessDrops formulations, patients’ postoperative medication costs are lowered from about $150 to $50. Of course, this is still a drop regimen that requires good compliance.

One drawback of combined formulations is the inability to decouple medications if, for example, more aggressive steroid treatment is needed but antibiotics are no longer necessary, or if a patient experiences steroid response with intraocular pressure spikes.

**MEDICATED PLUGS**

The use of punctal plugs to deliver medications is an avenue several ophthalmic companies have pursued. Dextenza (sustained release dexamethasone; Ocular Therapeutix) is a hydrogel punctal plug drug depot that rests in the canaliculus. It contains dexamethasone and slowly elutes the steroid into the eye over 4 weeks. The intracanicular depot is conjugated with sodium fluorescein to aid in viewing once it is placed in the eye.
This device is in phase 3 clinical trials for treatment of postoperative pain and inflammation.6

In phase 2 trials, the retention rate of this plug was 100% at day 14 and 97% at day 30.4 This is important because a major concern is dislodging of the drug depot, which would leave the patient without medication. This depot also showed good efficacy in decreasing pain and inflammation. At day 14, only 20% of treated patients needed rescue medications for pain or inflammation compared to 72.4% of patients receiving a placebo plug.4 Further, the treatment group showed superiority in decreasing inflammation (as measured by anterior chamber cell count) that was statistically significant (P < .005).6

INJECTIONS

There is increasing interest in the use of intracameral or intravitreal injections to deliver medication after cataract surgery. According to a recent survey on use of intracameral injections after cataract surgery in Europe, 74% of responding European ophthalmologists “almost always” use intracameral antibiotics.5 In the United States the level of acceptance is definitely lower, but it is growing. The Dropless Therapy (Imprimis Pharmaceuticals) formulations are compounded for use as injections after cataract surgery.

The benefits of injections over drops can be summarized by three C’s: compliance, cost, and convenience.

Compliance. Ease of compliance is an advantage for patients, but I think use of injections after cataract surgery may benefit the surgeons more by minimizing the risk of postoperative infections, especially endophthalmitis. The European Society of Cataract and Refractive Surgeons’ endophthalmitis study published in 2006, was a landmark research effort that confirmed that intracameral antibiotics at the end of cataract surgery decreased endophthalmitis rates.6,7 This study found a fivefold decrease in endophthalmitis with injection of cefturoxime at the conclusion of cataract surgery.6 Shorstein and colleagues, in the Kaiser Permanente health system in California, performed a robust study comparing intracameral antibiotics versus topical antibiotics after cataract surgery.8 They found a 22-fold decrease in endophthalmitis rates when intracameral antibiotics alone were used or were coupled with topical antibiotics. Interestingly, over the course of the 5- year study, the participating surgeons’ use of intracameral antibiotics climbed from 11% to 100%.8

Cost. Being more cost-conscious with postoperative medication regimens benefits both patients and payers. Transzonular injections of steroid plus antibiotic with TriMoxi (Imprimis Pharmaceuticals) eliminates the need for the patient to purchase both topical steroid and topical antibiotic. According to the drug price comparison website GoodRx.com, the price for one bottle of Vigamox (moxifloxacin HCl ophthalmic solution, Alcon) alone averages $160.3 Without even factoring in the cost of the steroid drop, an injection depot of TriMoxi would save a patient more than $300 in drop costs for both eyes. According to the American Academy of Ophthalmology, 1.82 million cataract surgeries were performed in the Medicare population in 2011.10 Using a lower estimate of the cost of moxifloxacin at $75/bottle, the cost in postoperative antibiotics alone to Medicare would have been $136 million in that year. Use of injectable medications after cataract surgery has real potential to lower those medication costs.

Convenience. The convenience of intraoperative injection centers around minimizing the instillation of topical drops for the patient. This may be challenging because of patients’ physical limitations from conditions such as rheumatoid arthritis or Parkinson disease that make instilling drops difficult. In addition, some patients are just uncomfortable with using eye drops and working around their eyes. If a typical drop protocol includes an antibiotic four times daily for 1 week, a nonsteroidal anti-inflammatory drug once daily for 1 month, and a steroid four times daily for 1 week, then tapered to twice daily for 1 week is used, a single injection of TriMoxi would reduce a patient’s drop burden by almost 100 drops per eye. For a patient who is averse to administering eye drops, this could mean the difference between proceeding with surgery or avoiding it.

CONCLUSION

The many impressive advances in cataract surgery in recent years have focused on providing a better intraoperative experience and a better quality of life and vision after surgery. New methods of postoperative drug delivery will continue to raise the bar in cataract surgery. With the availability of drug delivery options such as fixed-combination drops, intracameral drug depots, and formulations for transzonular injection, the armamentarium for post-cataract drug delivery has considerably broadened. The future is bright for further innovation in drug delivery, which will give patients more options for high quality surgical outcomes.


Mitch Ibach, OD, FAAO
- Corneal, Cataract, Refractive, and Glaucoma Surgery Specialist, Vance Thompson Vision, Sioux Falls, South Dakota
- (605) 361-3937; mitch.ibach@vancethompsonvision.com
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