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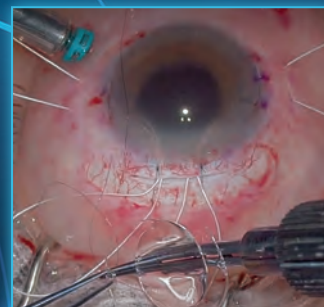
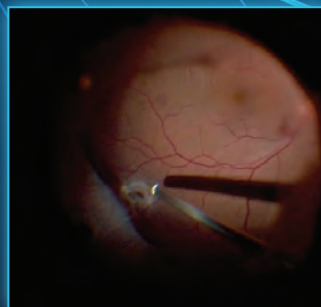
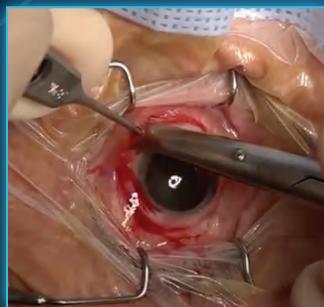
Retina Today

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WITH A SPECIAL SECTION
CRAFTED BY THE VBS

THE SURGICAL ISSUE

ALL THINGS RETINA SURGERY



ARDS MEETING COVERAGE WITH
CAROL L. SHIELDS, MD, AND
CHRISTINA Y. WENG, MD, MBA

REAL-WORLD OUTCOMES
FROM VITRECTOMY FOR
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Caution: Federal (USA) law restricts this device to sale by, or on the order of, a physician. Indications for Use: GRIESHABER® DSP instruments are a line of single-use vitreoretinal microinstruments which are used in ophthalmic surgery, for cases either in the anterior or the posterior segment. The GRIESHABER® Advanced Backflush Handles DSP are a family of instruments for fluid and gas handling in vitreoretinal surgery. **Warnings and Precautions:** • Potential risk from reuse or reprocessing GRIESHABER® DSP instruments include: foreign particle introduction to the eye; reduced cutting or grasping performance; path leaks or obstruction resulting in reduced fluidics performance. • Verify correct tip attachment, function and tip actuation before placing it into the eye for surgery. • For light fiber instruments: Minimize light intensity and duration of exposure to the retina to reduce risk of retinal photic injury. The light fiber instruments are designed for use with an ALCON® illumination source. • Good clinical practice dictates the testing for adequate irrigation and aspiration flow prior to entering the eye. If stream of fluid is weak or absent, good fluidics response will be jeopardized. • Use appropriate pressure supply to ensure a stable IOP. • If unwanted tissue gets engaged to the aspiration port, it should be released by interrupting aspiration before moving the instrument. **ATTENTION:** Please refer to the product labeling for a complete listing of indications, warnings, and precautions.

References: 1. Alcon data on file, 2020. 2. Alcon data on file, 2020. 3. Alcon data on file, 2020. 4. Alcon data on file, 2020. 5. Alcon data on file, 2020. 6. Alcon data on file, 2020. 7. Alcon data on file, 2020. 8. Alcon data on file, 2020. 9. Alcon data on file, 2020. 10. Alcon data on file, 2020.



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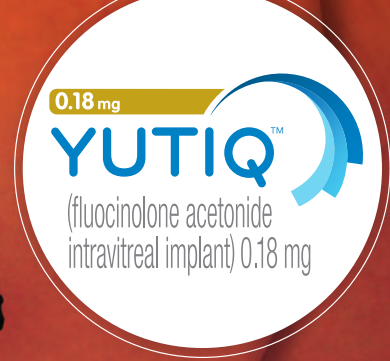
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YUTIQ® (fluocinolone acetonide intravitreal implant) 0.18 mg:

- **Proven to reduce uveitis recurrence at 6 and 12 months^{1*}**
[At 6 months—18% for YUTIQ and 79% for sham for study 1 and 22% for YUTIQ and 54% for sham for study 2 ($P < .01$). At 12 months—28% for YUTIQ and 86% for sham for study 1 and 33% for YUTIQ and 60% for sham for study 2.]
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*Study design: The efficacy of YUTIQ was assessed in 2 randomized, multicenter, sham-controlled, double-masked, phase 3 studies in adult patients (N=282) with noninfectious uveitis affecting the posterior segment of the eye. The primary endpoint in both studies was the proportion of patients who experienced recurrence of uveitis in the study eye within 6 months of follow-up; recurrence was also assessed at 12 months. Recurrence was defined as either deterioration in visual acuity, vitreous haze attributable to noninfectious uveitis, or the use of prohibited medications.^{1,3}

INDICATIONS AND USAGE

YUTIQ® (fluocinolone acetonide intravitreal implant) 0.18 mg is indicated for the treatment of chronic noninfectious uveitis affecting the posterior segment of the eye.

IMPORTANT SAFETY INFORMATION

CONTRAINDICATIONS

Ocular or Periocular Infections: YUTIQ is contraindicated in patients with active or suspected ocular or periocular infections including most viral disease of the cornea and conjunctiva including active epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, varicella, mycobacterial infections and fungal diseases.

Hypersensitivity: YUTIQ is contraindicated in patients with known hypersensitivity to any components of this product.

WARNINGS AND PRECAUTIONS

Intravitreal Injection-related Effects: Intravitreal injections, including those with YUTIQ, have been associated with endophthalmitis, eye inflammation, increased or decreased intraocular pressure, and choroidal or retinal detachments. Hypotony has been observed within 24 hours of injection and has resolved within 2 weeks. Patients should be monitored following the intravitreal injection.

Steroid-related Effects: Use of corticosteroids including YUTIQ may produce posterior subcapsular cataracts, increased intraocular pressure and glaucoma. Use of corticosteroids may enhance the establishment of secondary ocular infections due to bacteria, fungi, or viruses. Corticosteroids are not recommended to be used in patients with a history of ocular herpes simplex because of the potential for reactivation of the viral infection.

Risk of Implant Migration: Patients in whom the posterior capsule of the lens is absent or has a tear are at risk of implant migration into the anterior chamber.

ADVERSE REACTIONS

In controlled studies, the most common adverse reactions reported were cataract development and increases in intraocular pressure.

References: 1. YUTIQ® (fluocinolone acetonide intravitreal implant) 0.18 mg full U.S. Prescribing Information. EyePoint Pharmaceuticals, Inc. October 2018. 2. EyePoint Pharmaceuticals Receives FDA Approval of YUTIQ™ (fluocinolone acetonide intravitreal implant) 0.18 mg. Global Newswire. <https://www.globenewswire.com/news-release/2018/10/15/1621023/0/en/EyePoint-Pharmaceuticals-Receives-FDA-Approval-of-YUTIQ-fluocinolone-acetonide-intravitreal-implant-0-18-mg.html>. Accessed February 7, 2020. 3. Data on file.

Please see next page for Brief Summary of full Prescribing Information.



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2/2020
US-YUT-2000020

YUTIQ™ (fluocinolone acetonide intravitreal implant) 0.18 mg, for intravitreal injection
Initial U.S. Approval: 1963

BRIEF SUMMARY: Please see package insert for full prescribing information.

1. INDICATIONS AND USAGE. YUTIQ™ (fluocinolone acetonide intravitreal implant) 0.18 mg is indicated for the treatment of chronic non-infectious uveitis affecting the posterior segment of the eye.

4. CONTRAINDICATIONS. 4.1. Ocular or Periocular Infections. YUTIQ is contraindicated in patients with active or suspected ocular or periocular infections including most viral disease of the cornea and conjunctiva including active epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, varicella, mycobacterial infections and fungal diseases. **4.2. Hypersensitivity.** YUTIQ is contraindicated in patients with known hypersensitivity to any components of this product.

5. WARNINGS AND PRECAUTIONS. 5.1. Intravitreal Injection-related Effects. Intravitreal injections, including those with YUTIQ, have been associated with endophthalmitis, eye inflammation, increased or decreased intraocular pressure, and choroidal or retinal detachments. Hypotony has been observed within 24 hours of injection and has resolved within 2 weeks. Patients should be monitored following the intravitreal injection [see Patient Counseling Information (17) in the full prescribing information]. **5.2. Steroid-related Effects.** Use of corticosteroids including YUTIQ may produce posterior subcapsular cataracts, increased intraocular pressure and glaucoma. Use of corticosteroids may enhance the establishment of secondary ocular infections due to bacteria, fungi, or viruses. Corticosteroids are not recommended to be used in patients with a history of ocular herpes simplex because of the potential for reactivation of the viral infection. **5.3. Risk of Implant Migration.** Patients in whom the posterior capsule of the lens is absent or has a tear are at risk of implant migration into the anterior chamber.

6. ADVERSE REACTIONS. 6.1. Clinical Studies Experience. Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice. Adverse reactions associated with ophthalmic steroids including YUTIQ include cataract formation and subsequent cataract surgery, elevated intraocular pressure, which may be associated with optic nerve damage, visual acuity and field defects, secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera. Studies 1 and 2 were multicenter, randomized, sham injection-controlled, masked trials in which patients with non-infectious uveitis affecting the posterior segment of the eye were treated once with either YUTIQ or sham injection, and then received standard care for the duration of the study. Study 3 was a multicenter, randomized, masked trial in which patients with non-infectious uveitis affecting the posterior segment of the eye were all treated once with YUTIQ, administered by one of two different applicators, and then received standard care for the duration of the study. Table 1 summarizes data available from studies 1, 2 and 3 through 12 months for study eyes treated with YUTIQ (n=226) or sham injection (n=94). The most common ocular (study eye) and non-ocular adverse reactions are shown in Table 1 and Table 2.

Table 1: Ocular Adverse Reactions Reported in ≥ 1% of Subject Eyes and Non-Ocular Adverse Reactions Reported in ≥ 2% of Patients

Ocular		
ADVERSE REACTIONS	YUTIQ (N=226 Eyes) n (%)	Sham Injection (N=94 Eyes) n (%)
Cataract ¹	63/113 (56%)	13/56 (23%)
Visual Acuity Reduced	33 (15%)	11 (12%)
Macular Edema	25 (11%)	33 (35%)
Uveitis	22 (10%)	33 (35%)
Conjunctival Hemorrhage	17 (8%)	5 (5%)
Eye Pain	17 (8%)	12 (13%)
Hypotony Of Eye	16 (7%)	1 (1%)
Anterior Chamber Inflammation	12 (5%)	6 (6%)
Dry Eye	10 (4%)	3 (3%)
Vitreous Opacities	9 (4%)	8 (9%)
Conjunctivitis	9 (4%)	5 (5%)
Posterior Capsule Opacification	8 (4%)	3 (3%)
Ocular Hyperemia	8 (4%)	7 (7%)
Vitreous Haze	7 (3%)	4 (4%)
Foreign Body Sensation In Eyes	7 (3%)	2 (2%)
Vitritis	6 (3%)	8 (9%)
Vitreous Floaters	6 (3%)	5 (5%)
Eye Pruritus	6 (3%)	5 (5%)
Conjunctival Hyperemia	5 (2%)	2 (2%)
Ocular Discomfort	5 (2%)	1 (1%)
Macular Fibrosis	5 (2%)	2 (2%)
Glaucoma	4 (2%)	1 (1%)
Photopsia	4 (2%)	2 (2%)

(continued)

Table 1: Ocular Adverse Reactions Reported in ≥ 1% of Subject Eyes and Non-Ocular Adverse Reactions Reported in ≥ 2% of Patients

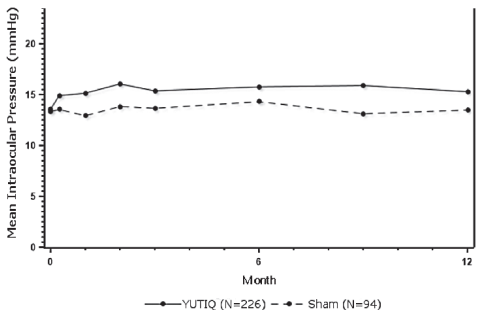
Ocular		
ADVERSE REACTIONS	YUTIQ (N=226 Eyes) n (%)	Sham Injection (N=94 Eyes) n (%)
Vitreous Hemorrhage	4 (2%)	0
Iridocyclitis	3 (1%)	7 (7%)
Eye Inflammation	3 (1%)	2 (2%)
Choroiditis	3 (1%)	1 (1%)
Eye Irritation	3 (1%)	1 (1%)
Visual Field Defect	3 (1%)	0
Lacrimation Increased	3 (1%)	0
Non-ocular		
ADVERSE REACTIONS	YUTIQ (N=214 Patients) n (%)	Sham Injection (N=94 Patients) n (%)
Nasopharyngitis	10 (5%)	5 (5%)
Hypertension	6 (3%)	1 (1%)
Arthralgia	5 (2%)	1 (1%)

1. Includes cataract, cataract subcapsular and lenticular opacities in study eyes that were phakic at baseline. 113 of the 226 YUTIQ study eyes were phakic at baseline; 56 of 94 sham-controlled study eyes were phakic at baseline.

Table 2: Summary of Elevated IOP Related Adverse Reactions

ADVERSE REACTIONS	YUTIQ (N=226 Eyes) n (%)	Sham (N=94 Eyes) n (%)
IOP elevation ≥ 10 mmHg from Baseline	50 (22%)	11 (12%)
IOP elevation > 30 mmHg	28 (12%)	3 (3%)
Any IOP-lowering medication	98 (43%)	39 (41%)
Any surgical intervention for elevated IOP	5 (2%)	2 (2%)

Figure 1: Mean IOP During the Studies



8. USE IN SPECIFIC POPULATIONS. 8.1 Pregnancy. Risk Summary. Adequate and well-controlled studies with YUTIQ have not been conducted in pregnant women to inform drug associated risk. Animal reproduction studies have not been conducted with YUTIQ. It is not known whether YUTIQ can cause fetal harm when administered to a pregnant woman or can affect reproduction capacity. Corticosteroids have been shown to be teratogenic in laboratory animals when administered systemically at relatively low dosage levels. YUTIQ should be given to a pregnant woman only if the potential benefit justifies the potential risk to the fetus. All pregnancies have a risk of birth defect, loss, or other adverse outcomes. In the United States general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2% to 4% and 15% to 20%, respectively. **8.2 Lactation.** Risk Summary. Systemically administered corticosteroids are present in human milk and can suppress growth, interfere with endogenous corticosteroid production. Clinical or nonclinical lactation studies have not been conducted with YUTIQ. It is not known whether intravitreal treatment with YUTIQ could result in sufficient systemic absorption to produce detectable quantities of fluocinolone acetonide in human milk, or affect breastfed infants or milk production. The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for YUTIQ and any potential adverse effects on the breastfed child from YUTIQ. **8.4 Pediatric Use.** Safety and effectiveness of YUTIQ in pediatric patients have not been established. **8.5 Geriatric Use.** No overall differences in safety or effectiveness have been observed between elderly and younger patients.

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THE SURGICAL ISSUE

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THE SURGICAL ISSUE

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THE PUZZLE OF SURGERY



Many retina specialists, particularly those who trained before the dawn of the anti-VEGF era, went into this field because they found satisfaction in surgery. There's a certain grace in the OR, a special elegance to the eye, that scratched an itch in those of us who became eye surgeons.

The orb was a puzzle that we had the privilege of solving. The retina and vitreous were the elements that called to us most, but we found that we loved the eye in its entirety.

We dedicate this issue of *Retina Today* to all things surgery: the procedures, the equipment, the finances, the strategies, the tactics. Specific techniques are discussed in this issue—you may find especially useful the two articles on scleral buckling and scleral pocket IOL suturing—as are topics that pertain to surgical strategies, such as performing vitrectomy without intravenous anesthesia.

We knew we couldn't prepare this issue without consulting the Vit-Buckle Society (VBS). In the past decade, the VBS has grown from a small consortium of savvy surgeons to a blossoming society of thought leaders and experts. VBS President R. Ross Lakhanpal, MD, tasked VBS up-and-comers Avni P. Finn, MD, MBA, and Basil K. Williams Jr, MD, with coordinating a series of articles for this issue's cover focus. To them and their team, we are grateful.

If you work in a private practice or have any responsibilities related to coding and reimbursement, then

you will likely enjoy this issue's coding column by AAO Coding and Practice Management Executive Joy Woodke, COE, OCS, OCSR. Ms. Woodke's contributions to each issue of *Retina Today*—whether in the pages of the issue proper or in our special quarterly publication *Retina Today Business Matters*—have become among our most popular articles. Understanding the nuances of coding and reimbursement is not something that many of us learn in our formal training, and yet it is one of the most important elements of our practice. Inaccurate coding may lead to underpayment—or worse, audits. Relying on an expert like Ms. Woodke to help educate yourself could be key to keeping your practice's finances in good shape.

We have paused our coverage of the COVID-19 pandemic—for now. We expect as the weather cools and indoor activities resume at a higher rate, more variables will be added to the equation. Disease spikes will once again affect our clinics.

When that happens, we'll be there to cover it. But for now, we operate. ■

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ASSOCIATE MEDICAL EDITOR



BROLUCIZUMAB NONINFERIOR TO AFLIBERCEPT IN PHASE 3 TRIAL IN DME; POST HOC ANALYSIS ALSO YIELDS POSITIVE DATA IN AMD

Brolucizumab 6 mg (Beovu, Novartis) achieved the primary endpoint of noninferiority to aflibercept 2 mg (Eylea, Regeneron) in mean change in BCVA at 1 year in the phase 3 KITE study in patients with diabetic macular edema (DME), Novartis announced in September. In a secondary endpoint, more than half of patients receiving brolucizumab were maintained on a 3-month dosing interval through year 1 after a loading phase, the company said in a press release announcing top-line results of the study.

KITE is an ongoing 2-year multicenter study that enrolled 360 patients with DME. Results from a second study in DME, KESTREL, are anticipated later this year, at which time Novartis will “assess next steps with health authorities,” according to the press release.

In other top-line KITE results

announced by the company, brolucizumab showed superior improvement compared with aflibercept in the secondary endpoint of change in central subfield thickness, over the period of week 40 through week 52. Brolucizumab also demonstrated an overall well-tolerated safety profile comparable to aflibercept; of note, the rate of intraocular inflammation was equivalent between the two drugs.

Separately, Novartis announced positive results from two post-hoc analyses of the phase 3 HAWK and HARRIER trials comparing brolucizumab and aflibercept in patients with wet age-related macular degeneration (AMD). In these analyses, presented at the Euretina 2020 Virtual Congress, investigators found that fewer patients receiving brolucizumab had early persistent fluid, defined as the pres-

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ence of intraretinal or subretinal fluid, through week 12 of treatment, compared with aflibercept patients. In patients with early persistent fluid, those treated with brolucizumab achieved greater BCVA gains and greater reductions in central subfield thickness at week 96 than those receiving aflibercept.

ORPHAN DRUG DESIGNATIONS IN RETINA ANNOUNCED

Two companies recently announced receipt of orphan drug designation from the US FDA for products they are developing for treatment of inherited retinal diseases.

Eyeveus is developing EYS611 for the treatment of retinitis pigmentosa (RP) as well as other degenerative retinal diseases, including late stage dry AMD and glaucoma. EYS611 is a DNA plasmid that encodes for the human transferrin protein. Recently published preclinical work showed that EYS611 was safe and effective for preserving photoreceptors and retina functionality in acute toxicity and inherited rat models of retinal degeneration.

Neurophth Therapeutics is developing NR082 for the treatment of Leber hereditary optic neuropathy (LHON) associated with *ND4* mutation. NR082 uses recombinant adeno-associated virus serotype 2 to deliver a genetically modified *ND4* gene via intravitreal injection.

ADVANCES IN NEW VERSIONS OF ANTI-VEGF DRUGS ANNOUNCED

Progress on two new versions of existing anti-VEGF therapies has recently been reported by the companies developing them.

Outlook Therapeutics has completed enrollment of 227 patients in a US-based phase 3 pivotal trial of

bevacizumab-vikg (Lytenava, or ONS-5010), which the company hopes will become the first US FDA-approved ophthalmic formulation of bevacizumab. The compound has already demonstrated safety and efficacy in a recently reported clinical experience trial, according to the company. Outlook is seeking approval for bevacizumab-vikg through a biologics license application, not through the biosimilar pathway, according to the company.

Separately, Samsung Bioepis and Biogen announced in October that the European Medicines Agency had accepted for review their marketing authorization application for SB11, a proposed biosimilar referencing ranibizumab (Lucentis, Genentech). Samsung Bioepis and Biogen have a commercialization agreement for SB11 and for SB15, a proposed biosimilar referencing aflibercept, in the United States, Canada, Europe, Japan, and Australia.

AAO TO LAUNCH ITS FIRST OPEN-ACCESS JOURNAL

The AAO will expand the *Ophthalmology* family of journals to include *Ophthalmology Science*, an online open-access journal focused on preclinical development, phase 1 and 2

clinical trials, laboratory-based work, ophthalmology informatics, and clinical science, according to a news release from the AAO. *Ophthalmology Science* will be available online only and will be supported by article processing charges, allowing access without a subscription fee. A discounted article processing charge will be available to AAO members. The journal will be published quarterly, with the inaugural issue in the first quarter of 2021.

MIDWEST PRACTICE JOINS RETINA CONSULTANTS OF AMERICA

Vitreoretinal Surgery, PA, a large multisurgeon practice in the US Midwest, is the latest practice to join the physician management services organization Retina Consultants of America, according to a September press release from the consultant group.

Vitreoretinal Surgery comprises 13 retina specialists and two retina fellows-in-training, in a total of seven offices serving Minnesota, North Dakota, South Dakota, Iowa, and Wisconsin. The physicians have been investigators in many randomized clinical trials evaluating treatments for vitreoretinal disorders, according to the release. ■



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CASE REPORT: EARLY-ONSET LARGE COLLOID DRUSEN



These lesions in young adults generally have a low risk profile.

BY PEDRO MANUEL BAPTISTA, MD; JOÃO HEITOR MARQUES, MD; RITA VIEIRA, MD; ANA CAROLINA ABREU, MD; MARIA JOÃO FURTADO, MD; AND MIGUEL RIBEIRO LUME, MD

Drusen are extracellular deposits between the basal lamina of the retinal pigment epithelium (RPE) and the inner collagenous layer of Bruch membrane. These deposits are usually considered an early pathologic sign of age-related macular degeneration (AMD) and are rarely observed in patients younger than 50 years. Nevertheless, different drusen patterns can occur at earlier ages in conditions including cuticular drusen, malattia leventinese, and large colloid drusen (LCD).

Advances in OCT technology have allowed clinicians to image the outer retinal structures with better definition, leading to better characterization of the features of retinal and RPE degeneration. This improvement has facilitated better distinction and differentiation between different drusen patterns, including those of early onset, such as LCD.

WHAT IS LCD?

LCDs are large (200–300 μm) yellowish, bilateral lesions with hyperpigmented borders scattered throughout the posterior pole, usually well identified on fundus examination. In most cases, LCDs appear on OCT B-scans as multiple convex or dome-shaped

THE ETIOLOGY AND CLINICAL

SIGNIFICANCE OF LCD REMAIN UNKNOWN.

EXAMINATION OF THE OCULAR FUNDUS

USUALLY REVEALS BILATERAL SOFT

MACULAR DRUSEN, TYPICALLY

TEMPORAL TO THE FOVEA.

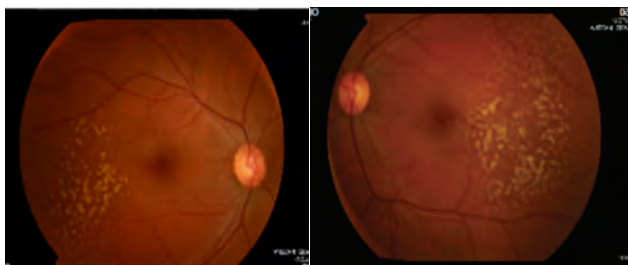
structures outside of the RPE, with medium homogeneous internal reflectivity and marked attenuation of the ellipsoid zone overlying the LCD. These drusen are homogeneously hyperfluorescent in late-phase fluorescein angiography images. In late-phase indocyanine green (ICG) angiography images, LCD are either hyperfluorescent or hypofluorescent and surrounded by a discrete hyperfluorescent halo.

The advent of the multimodal imaging approach that has occurred in recent years has increased the visual

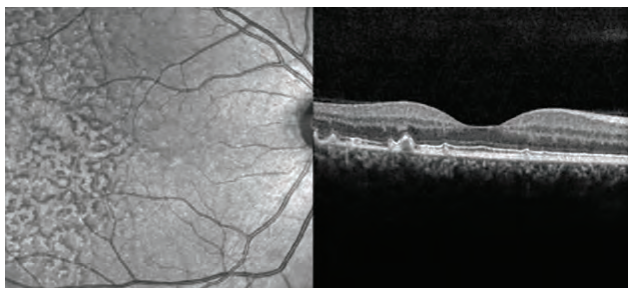
information at our disposal, allowing us to perceive the long-term prognostic risks of LCD.

CASE REPORT

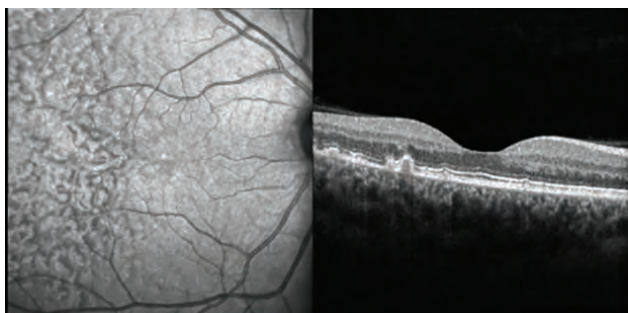
Here we present the case of a patient with LCD seen in the ophthalmology department of Centro Hospitalar e Universitário do Porto. The eye was imaged with spectral-domain OCT (SD-OCT) and autofluorescence (Spectralis SD-OCT, Heidelberg Engineering), color fundus photography, and fluorescein angiography.



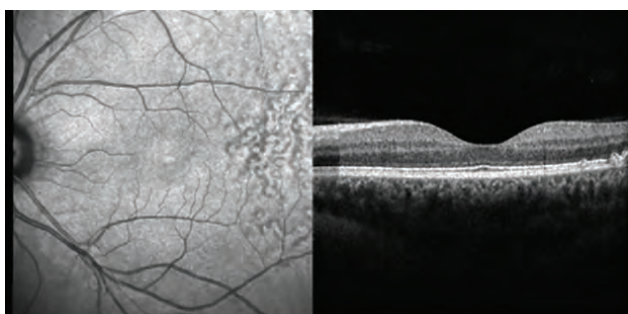
Figures 1 and 2. Color fundus photography images for left and right eyes at presentation.



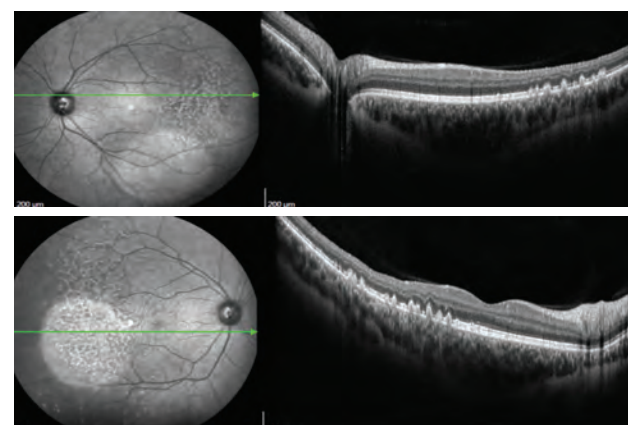
Figures 3 and 4. SD-OCT demonstrated large drusen in the temporal macula bilaterally, with no changes within the retina outside the foveal area.



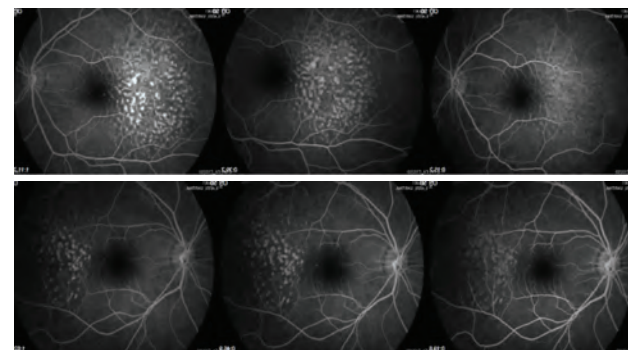
Figures 5 and 6. Three years after initial evaluation, OCT results remained similar.



Figures 7 and 8. Hyperautofluorescent lesions appeared 3 years after initial presentation.



Figures 9 and 10. Four years after initial evaluation, SD-OCT showed a characteristic sawtooth pattern, similar to the findings in the initial exam.



Figures 11 and 12. Lesions showed late hyperfluorescence with progressive staining but no diffusion on fluorescein angiography at 4 years follow-up.

A 37-year-old woman was referred for ophthalmology consultation because of a pterygium in her left eye. At presentation, the patient was asymptomatic, with BCVA of 20/20 OD and 20/20 OS. No clinically relevant personal or family ophthalmology history was reported. A biomicroscopy examination revealed a grade 2 pterygium in the left eye with no other changes. On examination of the ocular fundus, large bilateral macular drusen with temporal predominance were found, and a retinal imaging study was requested.

Color fundus photography images are presented in Figures 1 and 2. SD-OCT demonstrated large drusen in the temporal macula bilaterally, with no changes within the retina outside the foveal area (Figures 3 and 4).

Three years after our initial evaluation, OCT remained similar (Figures 5 and 6) and the lesions appeared with hyperautofluorescence (Figure 7 and 8). Four years after the first evaluation, SD-OCT showed the characteristic sawtooth pattern, similar to the findings in the initial exam (Figures 9 and 10). Additionally, on fluorescein angiography, the lesions showed late hyperfluorescence with progressive staining but no diffusion, attesting to the stability of the disease (Figures 11 and 12).

DISCUSSION

Early-onset drusen (age < 50 years) are rarely seen and can be divided into cuticular drusen, malattia leventinese, and LCD. The etiology and clinical significance of LCD remain unknown. Examination of the ocular fundus usually reveals bilateral soft macular drusen, typically temporal to the fovea.

Recently, Roberti and colleagues described some OCT patterns that can help to differentiate LCD from the other patterns previously mentioned; on OCT, LCDs usually appear as sub-RPE convex lesions configuring retinal pigment epithelial detachments in a sawtooth pattern, with a height-to-base ratio close to 1; intermediate reflectivity, greater in the core in relation to the periphery; and attenuation of the ellipsoid zone.¹ Additionally, a decrease in the thickness of all retinal layers is observed due to the compression effect, although the sensorineural retina is normally preserved. On en face images, the drusen appear with a hyperreflective center surrounded by a hyporeflective halo, which in turn is surrounded by two rings, one hyper- and the other hyporeflective.

Fluorescein angiography usually shows heterogeneously hyperfluorescent lesions in the late phase with progressive impregnation. The late phase of ICG angiography shows hypo- or hypercyanescent lesions with a hypocyanescent halo, described as a donut appearance. Finally, despite variability, LCDs are hyperautofluorescent surrounded by a halo of reduced autofluorescence.

LCDs are typically associated with minimal functional deficits, and therefore patients tend to be regarded as having good prognosis with no progression to advanced AMD. Guigui et al proposed that smaller lesions actually reflect an involutional phase.² In their series of 22 eyes of 11 patients, there was no progression to advanced forms of AMD during 3 years of follow-up, but the risk of long-term evolution is unknown. Nevertheless, there has been a report of a case of polypoidal choroidal vasculopathy in an eye with LCD.³

Sakurada et al estimated a 5-year risk of progression to geographic atrophy (GA) and choroidal neovascularization (CNV) for patients with cuticular drusen.⁴ The authors identified three different phenotypes of cuticular drusen, the last of which being associated with LCD. This third phenotype was found to have increased risk of GA and CNV over the 5-year period of the study.⁴

CONCLUSION

The advent of multimodal imaging studies has revolutionized clinicians' approaches to numerous retinal pathologies. In the presence of known changes with atypical presentations, multimodal imaging is an essential tool for better diagnosis, in order to achieve better risk stratification and support subsequent therapeutic decisions. ■

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ASPEN RETINAL DETACHMENT SOCIETY MEETING COVERAGE: OCULAR ONCOLOGY AND RETINAL GENE THERAPY



Few people would have guessed that the 2020 meeting of the Aspen Retinal Detachment Society (ARDS) would be the final in-person retina meeting of the year. The COVID-19 pandemic was a nascent and misunderstood threat when our first speakers took the stage at the end of February. Indeed, by the time the meeting wrapped up on March 4, the US Centers for Disease Control and Prevention was reporting an average of 12 new cases per day; a month later, it was reporting an average of 26,025 per day.¹

Those who attended this year's meeting were fortunate enough to hear from an array of speakers who shared their expertise and experience on a range of topics. Every year, the ARDS collaborates with Retina Today to highlight some of the meeting's top talks.

This year, we begin with a summary of the Taylor Smith and Victor Curtin lecture, which was awarded to Carol L. Shields, MD. Dr. Shields is a foundational mind behind our understanding of ocular oncology, and the ARDS selection committee is proud to have her join the ranks of other Curtin-Smith lecture recipients.

In another presentation, Christina Y. Weng, MD, MBA, addressed the topic vaulting retina toward the future: gene therapy. For patients with inherited retinal diseases—many of which are currently untreatable—the promise of gene therapy could be the difference between sight and blindness. Retina holds the distinction of being the first field of medicine to have a gene therapy approved by the US FDA. But we are far from finished with advancing this technology. Retina's hunger for further improvement should be a source of pride for us all.

—Timothy G. Murray, MD, MBA

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INTRAOCULAR TUMORS: A LOOK INTO THE FUTURE

The Taylor Smith and Victor Curtin Lecture was given by Carol L. Shields, MD, at this year's meeting.



**Presentation by Carol Shields, MD
Summarized by
Jonathan F. Russell, MD, PhD**

In this year's Victor Curtin and Taylor Smith Lecture, titled "Intraocular Tumors: A Look Into the Future," Carol L. Shields, MD, reviewed recent work she and her colleagues completed and ventured some ideas about where ocular oncology is headed. This article summarizes portions of her presentation.

UVEAL MELANOMA

A recent paper by Shields and colleagues delineated the multimodal imaging findings (OCT, autofluorescence,

B-scan) helpful for evaluation of small choroidal melanocytic tumors.¹ In a large cohort of choroidal nevi, they identified risk factors for transformation to melanoma. Risk factors included thickness greater than 2 mm on B-scan ultrasonography, subretinal fluid on OCT, symptoms of vision loss (20/50 or worse on Snellen acuity), orange pigment on autofluorescence, hypoechogenicity on B-scan, and diameter greater than 5 mm by fundus photography. Each risk factor has a multimodal imaging correlate. The most important risk factor was thickness greater than 2 mm.² Similarly, as the number of risk factors present increases, the risk of transformation from nevus to melanoma within 5 years escalates.

Uveal melanoma is often treated with plaque radiotherapy, which is effective but can cause complications

such as radiation retinopathy. Anti-VEGF therapy seems to lessen the visual decline associated with radiation maculopathy, and this was confirmed in a large comparative analysis of patients at 1, 2, 3, and 4 years post-plaque.^{3,4,5} In her lecture, Dr. Shields said she typically administers intravitreal bevacizumab (Avastin, Genentech) every 4 months after plaque brachytherapy for uveal melanoma to prevent or minimize radiation maculopathy.⁵

A light-activated nanoparticle therapy (AU-011, Aura Biosciences) is in development for treatment of uveal melanoma. This nanoparticle binds selectively to tumor cells. The nanoparticle is coupled with a photosensitive drug, and application of laser causes immediate necrosis of the tumor. This drug candidate has been tested in a limited number of patients,

with preliminary data suggesting preservation of visual acuity much better than plaque radiotherapy. This nanoparticle can control tumor growth, although slightly less (with current methods) in comparison to plaque brachytherapy. There is associated anterior and posterior segment inflammation, which might imply an immune response that could have an impact for circulating tumor cells. Trials are ongoing.

Regarding the genetics of uveal melanoma, Shields and colleagues found that the risk for metastasis is high if mutations are present on chromosomes 3 and 8, whereas the risk is low if no mutations are found on these chromosomes.⁶

Vichitvejpaisal and colleagues⁷ used The Cancer Genome Atlas to classify uveal melanoma based on genetics into four classes, A through D, with classes C and D having higher risk of metastasis at 4 years than A and B. Adjuvant sunitinib (Sutent, Pfizer) can be used to prevent metastasis in patients with class C and D disease; this tyrosine-kinase inhibitor has a moderate effect that appears more pronounced in younger patients.⁸

When uveal melanoma metastasizes, experimental treatments include immune mobilizing monoclonal T-cell receptors against cancer, or ImmTACs (Immunocore). ImmTACs are bispecific molecules that bind to melanoma cells and T-cells to facilitate the T-cell attacking the melanoma. This therapy requires weekly infusions but can be remarkably effective.

A recent paper suggests the involvement of protein kinase C in uveal melanoma metastasis, and treatments targeted at this molecule are in development.⁹

UVEAL METASTASES

In a recent study of more than 1,000 patients with uveal metastasis, nearly two-thirds of patients had a primary cancer site of either breast or lung.¹⁰ Most uveal metastases occur in middle-age or older adults.¹¹ Children with

uveal metastases have worse survival rates than adults. Women with uveal metastases have a better prognosis than men because they have a higher incidence of breast cancer that can be controlled with novel systemic therapies.

Whether the primary cancer is discovered before the uveal metastasis or the uveal metastasis is discovered before the primary cancer, no effect on survival has been noted. Breast cancer is usually discovered before uveal metastasis is noted, whereas uveal metastasis from lung cancer is usually found before the lung cancer itself. When small choroidal metastases are present, photodynamic therapy is effective.¹²

RETINOBLASTOMA

Today, 99% of patients with retinoblastoma (RB) survive, and the globe is salvaged in 95% of patients. Treatment is with chemotherapy, utilizing various modalities including intravenous chemoreduction for bilateral RB, intra-arterial chemotherapy for unilateral RB, intravitreal chemotherapy for active vitreous seeds, and intracameral chemotherapy for active aqueous seeds. Following intravenous chemotherapy, 50% of patients have 20/40 or better VA, and survival is excellent out to 20 years.¹³

Enucleation is performed in about 5% of cases, but it is not curative in all patients. In the United States, at 5 years, despite enucleation, 4% of patients have a metastasis, and death occurs in 2% of patients. In high-income countries such as the United States, the mean age at diagnosis of RB is 14 months, and only 0.3% of patients die from RB metastasis. In contrast, in low-income countries, the mean age at diagnosis is 31 months, extraocular extension is common, and 19% of patients die from RB metastasis.¹⁴

CONCLUSION

In closing, Dr. Shields said she envisions a future in which ophthalmologists try to prevent the development of uveal melanoma, perhaps through annual examinations and self-exams,

▶ Dr. Shields Summarizes Her Talk



▶ bit.ly/ARDSShields

use of artificial intelligence strategies, and treatment of borderline lesions rather than waiting for growth. For detection and prevention of RB, she envisions germline testing at birth, pre-implantation genetic diagnosis, screening to detect early lesions, and perhaps even the use of gene therapy.

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SUBRETINAL GENE THERAPY

This new technology is filled with promise.



Presentation by
Christina Y. Weng, MD, MBA
Summarized by
Jonathan F. Russell, MD, PhD

At this year's meeting, Christina Y. Weng, MD, MBA, delivered an update on subretinal gene therapy. This article summarizes portions of her presentation.

BASICS OF GENE THERAPY

Gene therapy was first suggested as a potential treatment for human disease in 1972, and the era of ocular gene therapy began with two seminal papers in 1994.^{1,2} Twenty-five years later, in 2019, the US FDA reported that it had more than 800 applications for cell and gene therapies, reflecting tremendous growth in the field.

Gene therapy involves introducing genes into host cells to treat human disease. Gene therapy encompasses gene augmentation (for autosomal-recessive loss-of-function inherited retinal diseases such as *RPE65*-associated retinal dystrophy), gene suppression or inactivation (for autosomal-dominant gain-of-function diseases), and use of gene therapy to create a biofactory (for wet age-related macular degeneration [AMD] and other complex disorders).

Current gene therapies use viral vectors to introduce a transgene into host cells. The host cells then produce the protein product of the transgene. Alternative methods that do not require viral vectors are being explored, such as nanoparticles and iontophoresis, but these are in earlier stages of investigation.

SUBRETINAL DELIVERY

Both intravitreal and suprachoroidal approaches to gene delivery are being

explored, and there are advantages and disadvantages to each. Subretinal delivery requires vitrectomy, and the gene product is transduced only in the area of the surgically induced bleb.

Intravitreal delivery could potentially induce panretinal gene expression, and it is a safe and familiar procedure. A potential downside, however, is that it may not achieve optimal efficiency of transduction to outer retinal cells. Another potential disadvantage is that the intravitreal approach may result in extraocular biodistribution that could induce an inflammatory response.

The first FDA-approved gene therapy in the United States is voretigene neparvovec-rzyl (Luxturna, Spark Therapeutics). This therapy, approved for treatment of biallelic *RPE65* inherited retinal dystrophy, uses an adeno-associated virus (AAV)-2-based vector that encodes the *RPE65* transgene. In the phase 3 study of the therapy, the primary outcome was not visual acuity but rather change in performance in a multiluminance mobility test at 1 year after gene therapy. This outcome measure was significantly improved in patients who received treatment.³ Secondary outcomes, which included Goldmann visual fields and full-field stimulus threshold, also improved with treatment.

Other gene therapies in development include NSR-REP1 (Nightstar Therapeutics), an AAV-2-based therapy aimed at treating choroideremia, an X-linked recessive disease. This gene therapy also uses subretinal delivery. In a phase 1/2a trial, the therapy significantly improved BCVA.⁴ A phase 3 trial is in progress.

RGX-314 (RegenxBio) is an AAV-8-based vector carrying a gene encoding a monoclonal anti-VEGF antibody. It is placed in the subretinal space in patients with wet AMD. In a phase 1/2a clinical trial, investigators

▶ Dr. Weng Talks Gene Therapy



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observed a dose-dependent increase in protein expression with RGX-314, and patients who received the highest dose of gene therapy required no rescue therapy for 5 to 6 months after injection. The therapy was well tolerated. A phase 3b trial in patients with wet AMD will begin soon. The company is also exploring suprachoroidal delivery using the same therapy for treatment of wet AMD and diabetic retinopathy.

SURGICAL PEARLS

Before performing subretinal gene therapy with voretigene, Dr. Weng said, it is essential to confirm the diagnosis with genetic testing. Oral steroids are started 3 days before surgery day and continued for approximately 2 weeks. For those beginning to perform the procedure, an OR practice run may be valuable to ensure that all logistics are in place. This is important because the medication must be compounded and then surgically implanted within a certain time window after compounding.

General anesthesia is preferred in patients receiving voretigene, as most of these patients are children. The surgeon should consider setting up the injection apparatus and priming the syringe at the start of surgery. The apparatus consists of a 41-gauge cannula with a polyamide microtip connected to extension tubing, which is connected to the gene therapy syringe. Two syringes are provided in case there is a problem

with the first. Some surgeons use triamcinolone to ensure that the hyaloid is lifted.

To inject voretigene, the subretinal cannula is gently buried along the superotemporal arcade, taking care to avoid vessels or pathology. Once the retina blanches, injection can begin. Optional techniques include bevelling the 41-gauge cannula tip, creating a pre-bleb with balanced saline solution, or using intraoperative OCT. As the bleb crosses the fovea, the surgeon should consider slowing down the rate of injection. Once the injection is complete, it may be best to stay within the bleb for a few seconds before withdrawing the cannula to avoid reflux. One recent study in a porcine model showed that material can reflux out of subretinal injection blebs.⁵

CONCLUSION

After many years of investigation, gene therapy has entered the realm of reality in retinal therapy. Widespread application is currently limited by the technical expertise required to perform subretinal injections and by the high cost of the medication.^{6,7} Some of the pointers in Dr. Weng's presentation may help new users get up to speed on the procedure. ■

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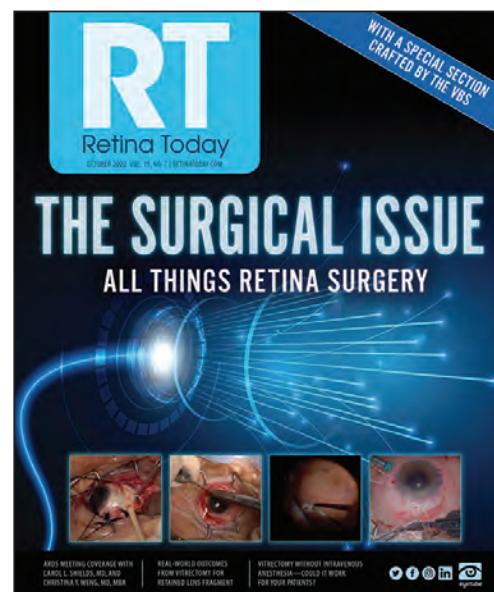
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RECOGNIZING RETINA CODING NUANCES BY PAYER



Answers to questions from the mailbag become clear as we find out who is the payer in each situation.

BY JOY WOODKE, COE, OCS, OCSR

The first rule of coding is to know the answer to this question: *Who is the payer?* Mastering the unique policies of insurance payers and understanding each payer's nuances will help pave the path to success. Variables to consider include medical necessity criteria, specific coverage type, and documentation requirements.

CMS and Medicare Administrative Contractors (MACs) publish local and national policies. Commercial, Medicaid, and Medicare Advantage plans either follow the rules of CMS or create their own. Staying informed and identifying the quirks of each unique policy for your most common procedures is recommended.

Here are a few questions from the mailbag that will improve your knowledge on payer policies.

Question: We received a claim denial. Are CPT codes 92134 (OCT) and 92201 or 92202 (extended ophthalmoscopy) bundled?

Discussion: The National Correct Coding Initiative (NCCI) bundles outlined in the Table show that

these two codes are not bundled. To explore further, let's ask ourselves: Who is the payer?

In this specific case, the physician practices in Vermont and the payer is Medicare. National Government Services (NGS), the MAC for that region, has published local coverage determination (LCD) L33567, which states:

When other ophthalmological tests (eg, fundus photography, fluorescein angiography, ultrasound, optical coherence tomography, etc.) have been performed, extended ophthalmoscopy will be denied as not medically necessary unless there was a reasonable medical exception that

the multiple imaging services might provide additive (non-duplicate) information.

Answer: NGS will deny 92134 and 92201 or 92202 unless there is a reasonable medical exception supporting performing the two services on the same day.

Question: The testing services performed today were CPT code 92134 (OCT) for macular edema and 92250 (fundus photography) for choroidal neoplasm. Can these codes be billed on the same day given the separate diagnoses?

Discussion: NCCI bundles CPT codes 92134 and 92250 with indicator 1, which

AT A GLANCE

- ▶ "Who is the payer?" is one of the most important questions one can ask in coding for retinal evaluations.
- ▶ Knowing the differences among Medicare, Medicaid, Medicare Advantage, and commercial insurance policies is key to understanding why some claims may be processed or denied.



TABLE. RETINA DIAGNOSTIC TESTING SERVICES, NCCI BUNDLES, VERSION 26.0

	EO Peripheral Retinal Disease 92201	EO Posterior Pole 92202	FA 92235	ICG 92240	FA/ICG 92242	FP 92250	Posterior Segment OCT 92134	Optic Nerve OCT 92133
EO Peripheral Retinal Disease 92201		Mutually Exclusive	Billable Same Day	Billable Same Day	Billable Same Day	Mutually Exclusive	Billable Same Day	Billable Same Day
EO Posterior Pole 92202	Mutually Exclusive		Billable Same Day	Billable Same Day	Billable Same Day	Mutually Exclusive	Billable Same Day	Billable Same Day
FA 92235	Billable Same Day	Billable Same Day		Mutually Exclusive	Mutually Exclusive	Billable Same Day	Billable Same Day	Billable Same Day
ICG 92240	Billable Same Day	Billable Same Day	Mutually Exclusive		Mutually Exclusive	Bundled	Billable Same Day	Billable Same Day
FA/ICG 92242	Billable Same Day	Billable Same Day	Mutually Exclusive	Mutually Exclusive		Bundled	Billable Same Day	Billable Same Day
FP 92250	Mutually Exclusive	Mutually Exclusive	Billable Same Day	Bundled	Bundled		Bundled	Bundled
Posterior Segment OCT 92134	Billable Same Day	Billable Same Day	Billable Same Day	Billable Same Day	Billable Same Day	Bundled		Mutually Exclusive
Optic Nerve OCT 92133	Billable Same Day	Billable Same Day	Billable Same Day	Billable Same Day	Billable Same Day	Bundled	Mutually Exclusive	
Bundled: Indicator 1 Mutually Exclusive: Indicator 0								
Abbreviations: EO, extended ophthalmoscopy; FA, fluorescein angiography; FP, fundus photography; ICG, indocyanine green angiography; OCT, optical coherence tomography.								

means unbundling may be allowed under certain circumstances (Table). Typically, this is allowed when a unique payer policy approves unbundling. Is that the case in this situation? Let's return to our question: Who is the payer?

The question was submitted from a practice in Texas, and the payer is Medicare. The MAC for that region, Novitas, has published LCD L35038, which states:

Fundus photography and posterior segment SCODI [scanning computerized ophthalmic diagnostic imaging of the posterior segment] performed on the same eye on the same day are generally mutually exclusive of one another ... The provider is not precluded from performing both on the same eye on the same day when each service is necessary to evaluate and treat the patient. The medical record should

clearly document the medical necessity of each service. Frequent reporting of these services together may trigger focused medical review.

Answer: Novitas will allow the unbundling of CPT codes 92134 and 92250 with the -59 modifier when medically necessary. Documentation should reflect the reason for the two tests the same day, and practices should be prepared for a focused medical review of these claims.

Question: A claim denial was received for CPT codes 67228-RT (panretinal photocoagulation) and 67028-RT (intravitreal injection). These two codes are not bundled. Why did the insurance carrier deny the claim?

Discussion: It is correct that 67228 and 67028 are not bundled under NCCI edits. In this instance, however, the payer is a commercial payer.

Answer: The descriptor for CPT code 67028 includes the language *separate procedure*. Although Medicare does not consider the separate procedure definition, many commercial payers recognize this distinction. Separate procedures can be billed if they are the only procedure provided during an encounter. As a result, commercial payers may deny CPT code 67028 billed the same day as other procedures, including, in this case, panretinal photocoagulation. ■

Current LCDs for each MAC can be explored at aao.org/lcds.

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A CHALLENGING CASE OF LARGE POST-TRAUMATIC RETINAL TEARS



A timely intervention saves vision.

BY MADHUSUDAN DAVDA, MD

A 15-year-old child presented to us after a cricket ball injury to his left eye with multiple large retinal tears. These tears were located in the inferior and temporal quadrants extending across 2 to 2.5 clock hours circumferentially (Figure 1). Unlike a dialysis, these tears had anterior flaps and extended quite posteriorly up to the equator (Figure 1). The tears were irregular and had ragged edges with fresh retinal and preretinal hemorrhages (Figure 2). The tears were also surrounded by a cuff of subretinal fluid that merged into the areas of commotio retinae (Figures 1 and 2).

The VA was 20/20 OS. The child did not complain of any defect in his visual field. After weighing the risks and benefits of various treatment options, we decided to perform an aggressive delimitation of the entire lesion with four to five contiguous rows of laser around the tears and subretinal fluid posteriorly, extending up to the ora serrata anteriorly (Figure 3). We chose laser delimitation as it represented the least invasive treatment option, compared to a large buckle or extensive vitreous surgery with tamponade.

The child continues to do well with 20/20 VA OS, with no evidence of progression of subretinal fluid for over a year following the treatment.

MADHUSUDAN DAVDA, MD

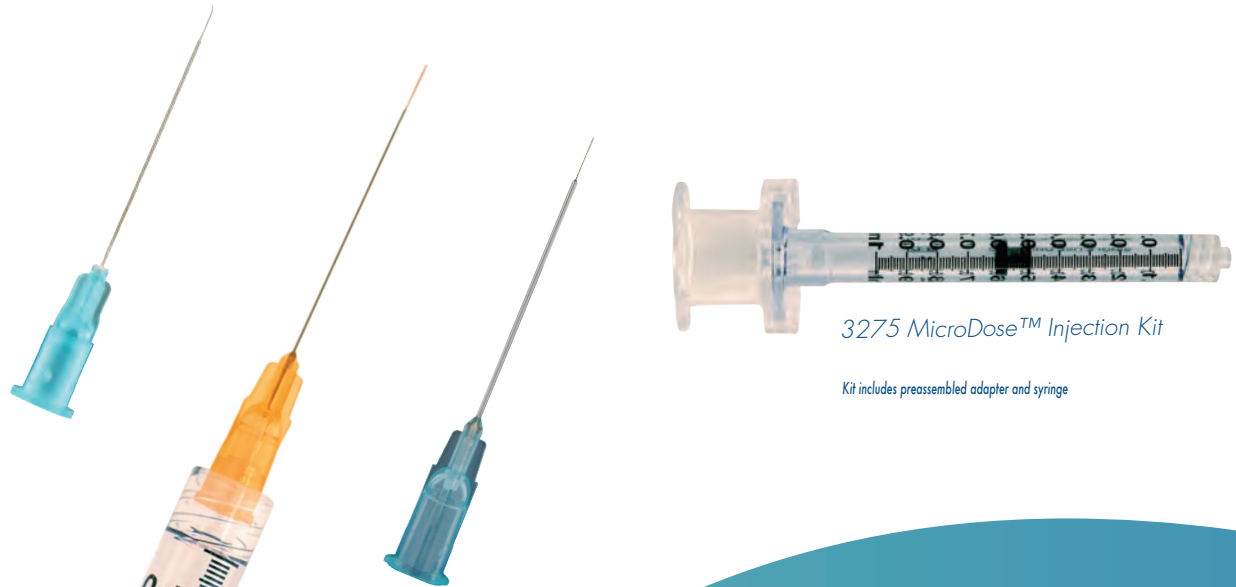
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Figure 1. Retinal tears with subretinal fluid and commotio retinae located in the inferior and temporal quadrant extending up to the equator.

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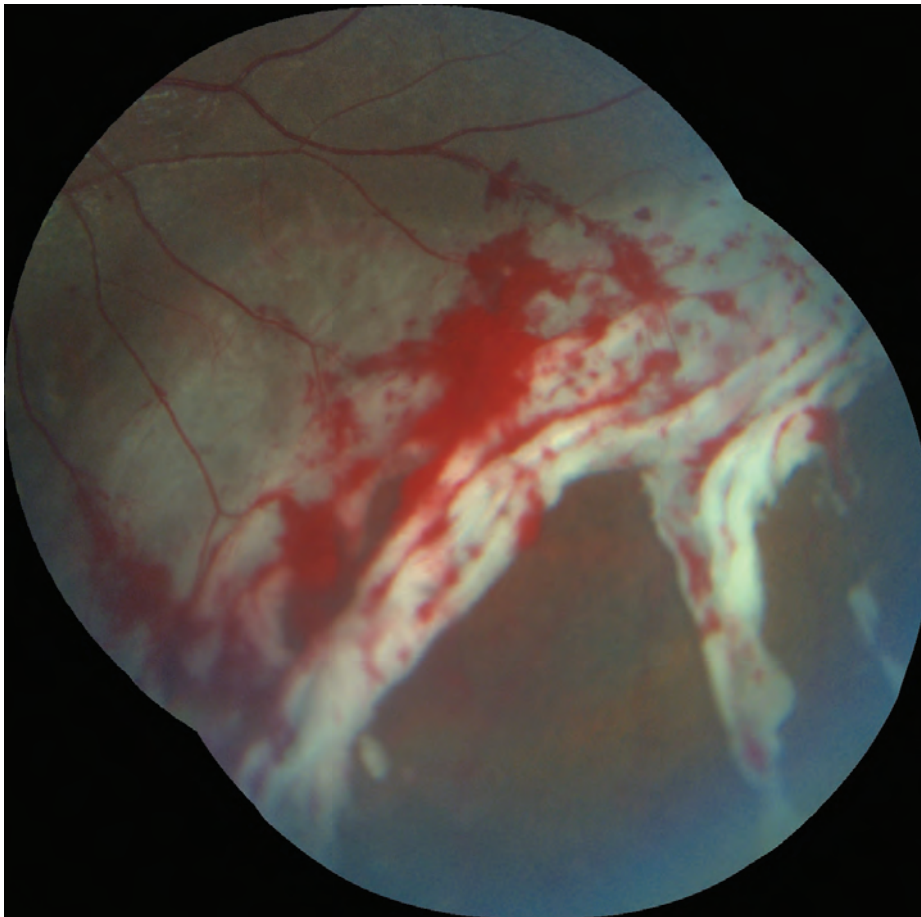


Figure 2. Close-up image showing the irregular and ragged tears with fresh retinal and preretinal hemorrhages.

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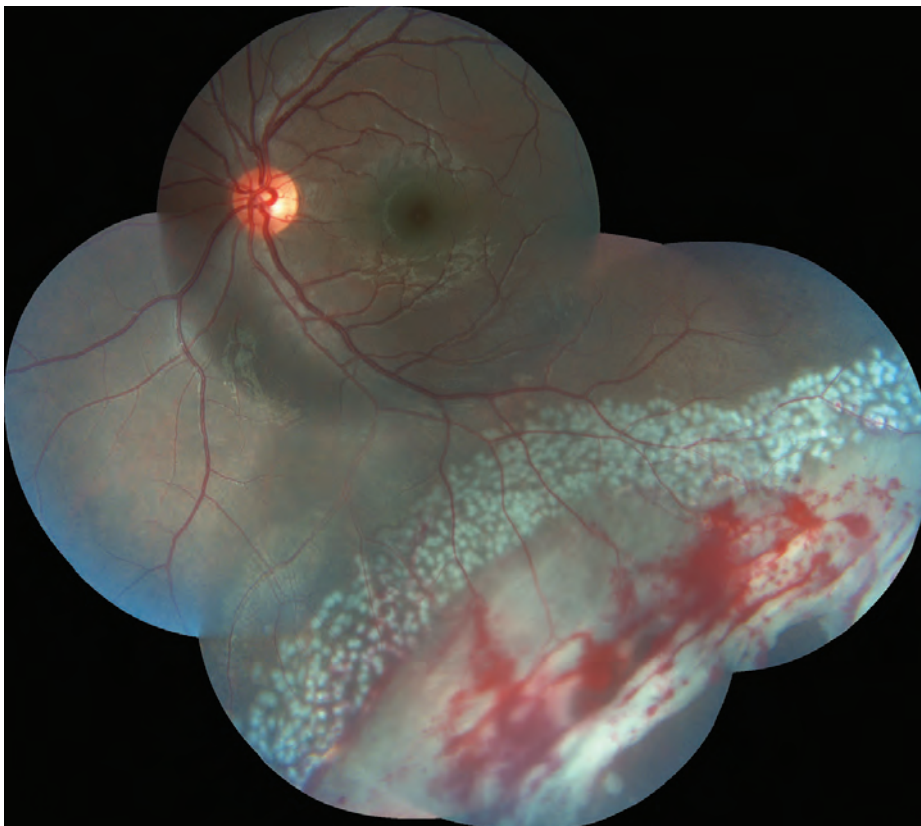


Figure 3. Post-laser delimitation images showing the aggressive rows of contiguous laser around the tears and subretinal fluid.



VBS and *Retina Today*: A Continued Partnership



The Vit-Buckle Society (VBS) and *Retina Today* have had a special relationship since the VBS first convened in a formal setting in 2013. We invited the publication to cover that inaugural meeting. They embraced the VBS's tone of candor, support, and curiosity (all while not taking ourselves too seriously), and collaborated with our founding members to chronicle the meeting.

That collaboration continues in this year's *Retina Today* surgery issue. When the editors invited the VBS to host a suite of articles that reviewed the events of the 2020 VBS virtual meetings, we couldn't say no. Continuing the mutual relationship between these two entities was a natural fit—and was one of the things that was unchanged during the COVID-19 era.

The COVID-19 pandemic has forced plenty of change in the field, and the VBS is proud that it has adapted to the conditions for hosting educational meetings. In this series of articles, you'll see that, although the 2020 VBS meetings have gone virtual, the quality of discussion remains at an all-time high.

—R. Ross Lakhanpal, MD
President, Vit-Buckle Society



Scleral Buckling Pearls



An Interview With Ajay E. Kuriyan, MD, MS, by Brian K. Do, MD

In Part 2 of the Vit-Buckle Society's Virtual Series, Ajay E. Kuriyan, MD, MS, imparted innumerable scleral buckling pearls. With residents, fellows, and fully trained surgeons who may not be comfortable with certain aspects of scleral buckling in mind, Dr. Kuriyan provided tips and tricks from start to finish that any one of us could find valuable.

Although scleral buckling has declined in popularity with the emergence of vitrectomy, it certainly still has a role in the vitreoretinal surgeon's armamentarium. In his presentation, Dr. Kuriyan listed a number of reasons to consider buckling in the repair of rhegmatogenous retinal detachments:

- They provide support of the vitreous base when used in conjunction with vitrectomy;
- They offer potential for avoiding unnecessary intraocular surgery;
- There is a high reattachment rate; and
- There are lower rates of retinal displacement with buckling compared with intraocular surgical options.

Below is an edited version of my interview with Dr. Kuriyan, followed by my notes on additional points that he made.

Brian K. Do, MD: Where do you see most people struggle as they're getting started with scleral buckling? What tips can you offer these folks?

Ajay E. Kuriyan, MD, MS: Whenever I adopt a new technique, I start by making a surgical checklist for supplies and intraoperative steps. I try to reach out to a surgeon experienced with the technique, if possible, to review my plan and help me anticipate any complications and understand how to manage them. Being as prepared as possible always helps me feel better about trying something new.

Another important factor is patient selection. Try to select patients with perfect views and easy-to-visualize breaks initially. If you're less comfortable with cryopexy, using

chandelier illumination and visualizing the break under the surgical scope may be helpful.

Dr. Do: One of the interesting things you propose is that we consider performing cryopexy before prepping and draping the eye. What are the advantages of making this change to the usual surgical sequence?

Dr. Kuriyan: I have to thank my colleague, Michael N. Cohen, MD, for introducing me to this technique. I like this technique because the fundus view is the best it will be all case, it's easy to manipulate the patient's head position, there are no concerns for contamination, you can put the indirect on yourself and manipulate it without baggies, you

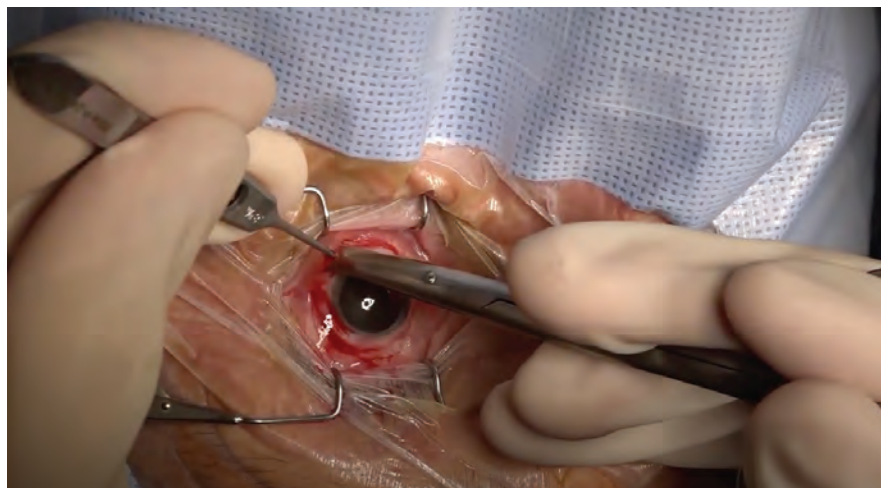


Figure 1. During scleral buckle surgery, isolation of rectus muscles helps to avoid muscle splitting and diplopia.

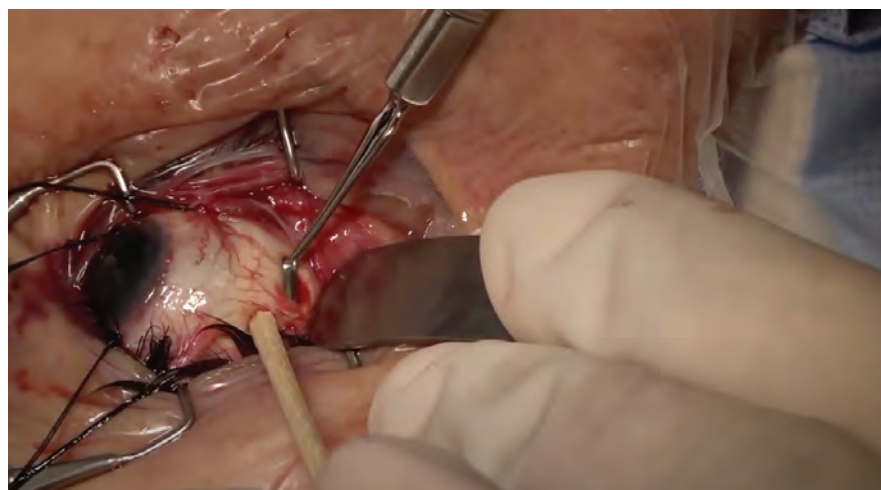


Figure 2. Use of belt loops for securing an encircling band during scleral buckle surgery is a preference of Dr. Kuriyan.

can use lenses that haven't been damaged during sterilization, and you're more comfortable and less prone to overheating when you're not wearing the surgical gown.

Dr. Do: Have you ever seen anyone use belt loops with an encircling element larger than a No. 41 band?

Dr. Kuriyan: Yes, I have used it for a No. 42 as well. You just need to make your belt loops longer from anterior to posterior. If you have very posterior pathology that you're trying to support with the band, this may be harder, but you can do it for most cases. Pulling the band on both sides of the belt loop—like stretching a rubber

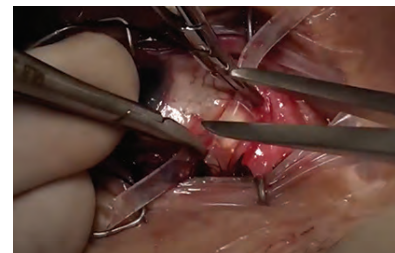
band—makes it thinner and easier to pass through a tight belt loop, if you didn't make it long enough.

Dr. Do: How do you decide in which cases drainage is appropriate?

Dr. Kuriyan: I usually don't drain if the break can be supported by a gas bubble or if there's only shallow fluid, to eliminate the risk for any sub-retinal hemorrhage. If there is a break that cannot be supported with a gas bubble, especially if the detachment is bullous or chronic, I tend to drain.

Dr. Do: How do you decide which eyes get a gas bubble and why?

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Scleral Buckling Pearls

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Dr. Kuriyan: If the break can be supported by a gas bubble, I usually use it to hasten the resolution of the fluid. Part of this is driven by the desire not to drain in those patients in order to decrease the risk of sub-retinal hemorrhage that extends to the macula. It's a rare complication but can potentially have a profound negative impact on the patient's post-operative vision.

Tenon Dissection and Isolation of Rectus Muscles

Dr. Kuriyan stressed that, when performing dissection of Tenon capsule and isolation of the rectus muscles, it is important to ensure visualization of bare sclera on either side of each muscle (Figure 1). Effective muscle isolation is vital to avoid splitting muscles and, secondarily, to prevent diplopia.

Marking the Break

Dr. Kuriyan recommended double-checking the mark or marks by depressing the area of the marks under direct visualization.

Element Selection

Dr. Kuriyan prefers the No. 41 band, which can easily be sutured or fixated to the sclera via belt loops. There are, of course, many other encircling elements that can be used. Both the No. 240 and No. 41 bands can be used with both symmetric and asymmetric "tire" elements. The No. 240 band can similarly be fixated using the belt-loop method (Figure 2).

(Continued on page 29)



Pars Plana Vitrectomy Versus Medical Treatment for Proliferative Diabetic Retinopathy



An Interview With María H. Berrocal, MD, and Yasha S. Modi, MD, by Avni P. Finn, MD, MBA, and Basil K. Williams Jr, MD

In Part 3 of the Vit-Buckle Society's Virtual Series, María H. Berrocal, MD, and Yasha S. Modi, MD, discussed the pros and cons of early vitrectomy versus medical therapy for patients with high-risk proliferative diabetic retinopathy (PDR). Dr. Berrocal outlined the advantages of early vitrectomy in patients with PDR, including lifting the hyaloid, which can act as a scaffold for neovascularization and traction. Dr. Modi discussed why a more conservative approach combining panretinal photocoagulation (PRP) and anti-VEGF therapy may pose less risk to the patient and potentially be just as efficacious.

Avni P. Finn, MD, MBA: Dr. Berrocal, what is your initial treatment for a patient with high-risk PDR?

María H. Berrocal, MD: I choose my initial treatment depending on whether the posterior hyaloid is completely detached or not. If there is a complete posterior vitreous detachment (PVD) and macular edema, I begin with anti-VEGF injections and add PRP later. If there is a complete PVD and no macular edema, I treat the patient with PRP up to 2 to 3 disc diameters (DD) from the arcades. If the hyaloid is not completely detached, particularly if there is vitreous hemorrhage or areas with fibrovascular proliferation, I usually offer vitrectomy. I explain the risk of progression with occurrence of tractional retinal detachment (TRD) and the benefits of long-term stabilization after vitrectomy with hyaloid removal. If the patient does not want surgery and has no diabetic macular edema (DME), I perform PRP as above. If the patient has associated DME, I start PRP inferiorly and concomitant anti-VEGF therapy and complete the PRP in two to three sessions. Subsequently, I treat the edema with anti-VEGF therapy, stressing the importance of compliance with appointments.

Basil K. Williams Jr, MD: What about you, Dr. Modi?

Yasha S. Modi, MD: My initial approach is combination anti-VEGF therapy and PRP, but even more important is the initial discussion with the patient regarding the severity of the disease, the likelihood of blindness in the absence of treatment, and the importance of *regular* follow-up to prevent severe complications. All first-visit patients in my clinic must agree and “sign” a verbal contract with me. I state, “I promise I will do everything possible to make sure you see for the rest of your life. However, you must promise me you will *never* miss an appointment with me or your primary care doctor or endocrinologist.” This small act of verbal commitment combined with tracking of patients through the electronic health record system has lowered my rate of loss to follow-up, which is where devastating ocular complications may occur.

When opting for combination PRP and anti-VEGF therapy over surgery, it's important to realize that this is *my* framework that I apply across the majority of my patients but not necessarily *all* patients. As clinicians, we have to gauge the likelihood of disease progression with the implemented

A Conversation with Dr. Paulus, MD, FACS, on Endpoint Management™ During COVID

We sat down with Dr. Yannis Paulus (University of Michigan Ann Arbor, MI) to learn about his recent study¹ on PASCAL® Endpoint Management™ for the treatment of DME and how it reduces the burden of anti-VEGF injections.

Q: Can you give us a brief overview of your recent study?

A: My team, led by Dr. Asad Durrani, conducted a study to assess the effects of tissue-sparing laser treatment in patients with DME and its impact on the number of intravitreal injections needed. We know that frequent injections are a huge burden on patients particularly given the COVID-19 pandemic, so we wanted to know if there was a better way to preserve vision and lessen this burden.

For our initial study, we conducted a retrospective analysis of nine eyes of seven patients with DME treated with Topcon's PASCAL 532 nm Synthesis™ Laser, using Endpoint Management (EpM) software. Five patients had proliferative diabetic retinopathy, one had severe non-proliferative diabetic retinopathy (NPDR), and one with mild NPDR. We evaluated anti-VEGF injection burden before and after treatment and performed t-tests to analyze the effect of EpM on VA and the number of injections required before and after treatment. Mean age was 66.71 ± 20.18 years. We have now expanded our study and included more than 30 patients.

Endpoint Management Treatment Parameters²:

- 30% of threshold laser with landmarks off
- Laser spot size of 200 micrometers
- Pulse duration of 15 milliseconds
- Spacing of 0.25 Φ apart.
- Mean number of spots was 671.33 ± 135.45

Q: What were the results of the study?

A: The mean number of intravitreal injections in the six month period prior to laser treatment was 4.55 ± 2.19 injections. In the six months following laser treatment, patients required 2.33 ± 1.58 injections ($p=0.01$). Mean VA before treatment was 0.48 ± 0.30 and after treatment was 0.54 ± 0.27 , which was not statistically significant ($p=0.12$).

Q: What does this mean for patients?

A: EpM treatment led to a significant decrease in the number of intravitreal injections required in the six month period immediately following treatment without compromising vision since there was no significant change in VA. EpM offers great benefits to patients by reducing the number of anti-VEGF injections and office visits, which minimizes the burden on patients and families, especially now, as patients with diabetes are at considerably higher-risk of complications from COVID-19 if they were to become infected.

Q: Is this your approach for treating patients with DME?

A: Absolutely. I'm a proponent of combination therapy and believe that treating patients with tissue-sparing laser therapy in conjunction with anti-VEGF affords them the best of both treatment worlds—we can help preserve vision and stretch the time between visits and treatments, which helps minimize potential exposure to COVID-19.



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1. Durrani AF, Paulus YM. Nondamaging focal retinal laser therapy for the treatment of diabetic macular edema reduces anti-vascular endothelial growth factor injection burden [ARVO Abstract]. Invest Ophthalmol Vis Sci. 2020; 61(7). Abstract nr 4882.
2. Patient cases, parameters and techniques provided by the physician/author.

therapy with a readiness to pivot to surgery if the disease were to worsen (eg, progressive contraction of fibrovascular membranes with worsening traction). We must also gauge the likelihood of the patient's compliance with return visits.

Dr. Finn: Dr. Berrocal, when do you consider early PPV for PDR?

Dr. Berrocal: I consider early vitrectomy in the following scenarios: eyes with attached hyaloid, severe disease with vitreous hemorrhage or areas of fibrosis, fibrovascular fronds, or TRD; patients who are poorly controlled or have concomitant renal involvement and hypertension; and patients who exhibit poor compliance or are at risk of losing insurance. If it is the patient's first visit, I perform a fluorescein angiogram to show the pathology, talk about surgery, give the patient educational pamphlets, and start PRP in the periphery. The patient returns in 2 to 4 weeks to continue the conversation. Eyes with the above characteristics can quickly progress to TRD despite PRP (Figure).

Dr. Williams: Dr. Modi, what research guides your decision of whether to start with anti-VEGF therapy and PRP?

Dr. Modi: What makes high-risk PDR management so difficult is that we lack high-quality randomized clinical trials to guide decision-making. The DRCR Retina Network's Protocol S was a landmark study that evaluated the initial treatment strategy for PDR with anti-VEGF therapy or PRP (with rescue anti-VEGF for DME).¹ However, only 1% of patients enrolled in that protocol had high-risk PDR with a diabetic retinopathy severity score of 85 (presence of preretinal or vitreous hemorrhage at presentation) or worse.

Thus, when we encounter patients with high-risk PDR, we must turn our attention to another well-executed multicenter randomized clinical trial called the PROTEUS study, which evaluated combination PRP plus anti-VEGF therapy versus PRP alone for initial management of high-risk PDR.² Regression of neovascularization at 1 year was seen in 93% of patients receiving combination PRP and anti-VEGF therapy, compared with 71% of those receiving PRP alone. Progression to surgery was seen in 2.5% of patients in the combination group and 11% in the PRP group, indicating three things:

1. A combination approach is superior to PRP alone;
2. the vast majority of patients managed initially with conservative measures did well; and
3. a small percentage of patients will still require surgery despite intensive PRP and anti-VEGF therapy.

These data provide me a reasonable framework to start with initial therapy of combination PRP with anti-VEGF therapy for these high-risk patients.

Dr. Finn: Dr. Berrocal, you presented some strong evidence for early vitrectomy with your own case series of

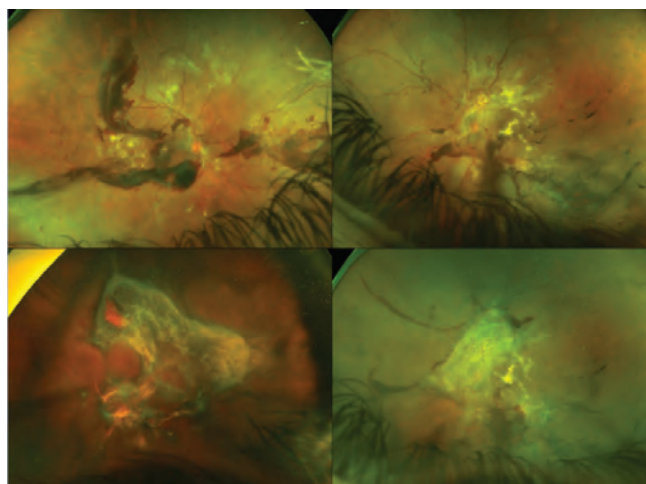


Figure. Rapid progression to TRD in both eyes can be seen in a patient with PDR who was at high risk of developing TRD. Development occurred in 8 weeks OD and 3 weeks OS during a clinical shutdown due to COVID-19.

60 patients who had PPV in one eye and PRP in the other eye. In these patients, 8% of eyes that had PPV ended up with hand motions (HM) or worse VA, whereas 36% of eyes treated with PRP had HM or worse VA. Similarly, series of patients treated with anti-VEGF therapy alone often show that lapses in follow-up due to illness, financial hardship, or noncompliance lead to poorer outcomes.^{3,4} Can you elaborate on what you see as the advantages of early PPV for PDR?

Dr. Berrocal: The advantages of early vitrectomy in PDR are most notable in eyes with a totally or partially attached hyaloid. Detaching the hyaloid during surgery removes the scaffold for neovascularization and prevents TRD or combined rhegmatogenous and TRD, as well as reducing the risk of macular edema, macular hole, and vitreomacular traction. With early vitrectomy we avoid the main complications of PDR that cause visual loss, reduce the need for many follow-up visits, and stabilize the eyes long-term. During the procedure, I always do PRP to the ora and up to 2 to 3 DD from the arcades. In young patients, the risk of cataract progression is small, and the procedure is essentially curative. With advances in vitrectomy, early PPV is a relatively simple procedure with minimal complications, and it is cost-effective to the patient and society. The advantages of stable visual acuity and reduction of the number of physician visits, time, and monetary costs are immense for individuals with diabetes.

Dr. Williams: Dr. Modi, what do you see as the drawbacks or potential risks of early PPV for PDR?

Dr. Modi: There is nothing better than beautifully executed diabetic surgery with total posterior hyaloid delamination that renders the patient stable in perpetuity. This is the goal for all surgeries, and we are fortunate as retina specialists

to execute to this standard in the majority of cases given recent technological advancements. However, some potential drawbacks occur when even small complications such as a retinal break balloon to proliferative vitreoretinopathy superimposed on PDR. One study reported retinal breaks in diabetic surgery in 4% of patients receiving 23-gauge PPV.⁵ Additionally, in cases in which the surgeon may not be able to achieve full delamination or when segmentation is incomplete, reoperation rates may be unacceptably high.

Finally, each surgical case poses interesting technical challenges, and each surgeon has unique skills and limitations. Thus, it is incumbent on each retinal surgeon to appraise each situation and calculate his or her own risk when considering surgical intervention as the first-line approach. ■

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(Continued from page 25)

Buckle Fixation

Scleral passes for buckle fixation are an art in and of themselves, and trainees should focus on getting comfortable with the associated ergonomics. Dr. Kuriyan said he prefers placing the band under the muscles before suture fixation, as opposed to preplacing the sutures, but the procedure can be successfully completed either way.

In the creation of belt loops, the partial-thickness radial scleral incisions can be made using Dr. Kuriyan's preference, which is a No. 64 Beaver blade (Beaver-Visitec International), or a guarded diamond blade or crescent blade. The partial-thickness dissection can then be performed using either a Castroviejo scleral dissector or a crescent blade. For performing this step, the use of a cotton-tipped applicator or other blunt instrument for globe fixation can be helpful.

Sleeve Placement and Tightening the Buckle

A helpful tip Dr. Kuriyan shared in his talk is to pull down toward the globe with the first end of the encircling band placed through the sleeve so as to help make room for insertion of the other end.

Dr. Kuriyan reviewed some basic geometry that helped attendees to visualize his suggestions in regard to buckle tightening. These principles supported his suggestion to tighten the band by 11 mm lengthwise in order to achieve an additional 1.75 mm of radial indentation. This can be approximated by having locking needle drivers on each end of the encircling band and tightening the band until the measured distance between them has increased by 11 mm.

Conjunctival Closure

Dr. Kuriyan recommended closure with gut suture to reduce risk of granuloma formation and to provide overall improved comfort for patients. Burying sutures may be helpful as well. ■

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Pearls for a Scleral Pocket IOL Suturing Technique



An Interview With Gabriela LópezCarasa, MD, by Camila V. Ventura, MD, PhD

In Part 4 of the Vit-Buckle Society's Virtual Series, Gabriela LópezCarasa, MD, presented a secondary IOL implantation technique. The technique she elegantly described was one inspired by the technique of scleral fixation without conjunctival dissection to prevent suture erosion, originally described by Richard S. Hoffman, MD. In addition to Dr. Hoffman's scleral pockets, she integrated a cow-hitch knot to provide two-point fixation and prevent lens tilt.

Camila V. Ventura, MD, PhD: Please briefly describe the secondary IOL implantation technique you chose for this case (Video).

Gabriela LópezCarasa, MD: The first step is to create the scleral pockets. I start by making clear corneal incisions 180° apart using a diamond knife, which will facilitate proper final positioning of the IOL haptics. Then, scleral pockets are created extending 3 mm posteriorly from the clear corneal incision using a crescent blade (Figure 1).

After placing a 23-gauge infusion cannula, I create a 7-mm sclerocorneal incision, and sutures are preplaced in the wound prior to fixating the IOL to avoid hypotony.

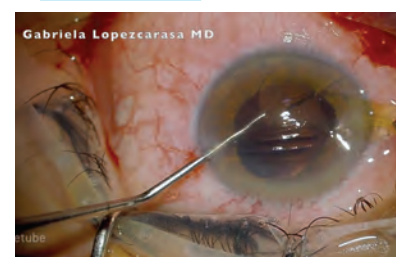
A 10-0 nylon suture and a 30-gauge needle are used to create sclerotomies 2 mm apart from each other in order to externalize the Gore-Tex CV-8

(polytetrafluoroethylene [PTFE], W.L. Gore & Associates) suture. The 30-gauge needle is used for docking the nylon suture, which is knotted at both ends to be used as a loop for placing the PTFE suture.

The PTFE suture is then pulled through the sclerotomy using the 30-gauge needle, 3 mm from the limbus. The nylon suture is externalized, either with a hook or forceps, to make a loop so that I can pull the PTFE suture out from the sclera with the nylon suture. The same steps are repeated for the other end of the PTFE suture.

For the cow-hitch knot, I use the same 10-0 nylon suture. First, both ends are passed through the eyelets of the IOL haptics. Then the PTFE suture is passed into the nylon loop and pulled through the eyelet to anchor the PTFE loop and create a two-point fixation knot on the haptics (Figure 2).

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The IOL is then placed into the eye, and the sutures are pulled to position the IOL behind the iris and into the ciliary sulcus. My IOL preference for this technique is the one-piece CZ70BD IOL (Alcon), but an AcrySof MA60 IOL (Alcon) also works well.

After IOL placement, the PTFE sutures are retrieved from the scleral pocket with a Sinskey hook to externalize both ends, and a 3-1-1 knot is

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made and placed under the scleral pocket roof. Finally, the sclerocorneal wound is closed.

Dr. Ventura: What are the potential advantages and pitfalls of this technique?

Dr. LópezCarasa: The most significant advantage of the scleral pocket technique is the reduction of surgical time because there is no need for conjunctival dissection and scleral flap creation. The technique also avoids the induced astigmatism usually observed with a scleral flap technique. Moreover, by creating scleral pockets you prevent exposure and erosion of the suture, reducing the incidence of IOL displacement, luxation, and endophthalmitis.

The biggest pitfall with this technique is the possibility of not forming the scleral pockets correctly in size, depth, and length. This initial step requires attention and precision to avoid complications such as perforation of the sclera, bleeding, creation of a superficial scleral pocket, and malpositioning of the IOL.

Dr. Ventura: What pearls can you offer for making this technique go as smoothly as it appears in your video?

Dr. LópezCarasa: My suggestions are as follows:

- Review the technique and watch surgical videos to get yourself ready for surgery.
- Before you begin the surgery, make sure you have everything you need handy, including a diamond knife, crescent blade, 30-gauge needle, 10-0 nylon and PTFE sutures, and a Sinsky hook.
- The depth of the clear corneal incision must be between 300 and 400 μ m.
- As you create the scleral pocket with the crescent blade, make sure you dissect the sclera moving the blade from side to side in a downhill movement.
- Avoid creating the scleral pockets at the 3 and 9 clock positions to prevent damaging the long posterior ciliary arteries.
- The scleral pockets should be at least 3 mm long to position the IOL behind the iris and in the posterior chamber.
- When you perform the sclerotomies to externalize the PTFE sutures, make sure the sutures traverse the pockets before continuing with the procedure.
- Using a 30-gauge needle to perform the sclerotomies, you will prevent leakage.

Dr. Ventura: Why do you choose this technique over others, or are there certain circumstances in which you like it better?

Dr. LópezCarasa: I want to emphasize that the best surgical technique is the one that works for you. That being said, I think this is a very sophisticated technique for secondary IOL



Figure 1. A crescent blade is used to create scleral pockets 3 mm from a clear corneal incision.

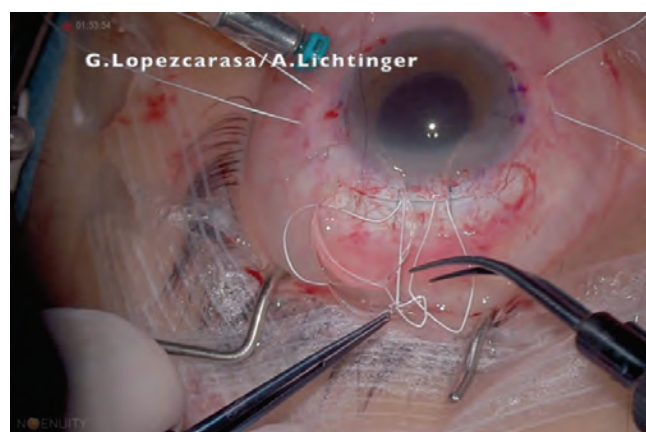


Figure 2. For the cow-hitch knot, both ends of the nylon suture are passed through the eyelets of the IOL haptics. Then the PTFE suture is passed into the nylon loop and pulled through the eyelet to anchor the PTFE loop and create a two-point fixation knot on the haptics.

implantation. Although I consider it challenging, great results can be achieved if you train and practice enough. Given that it prevents suture erosion and provides outstanding stabilization for the IOL, this technique can yield excellent visual results for patients without capsular support. ■

Dr. LópezCarasa wishes to thank Alejandro Lichtinger, MD, for educating and assisting her on the surgery discussed in this article.

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Practice-Building Pearls for New Associates



An Interview With Nika Bagheri, MD, by Kyle D. Kovacs, MD

During Part 4 of the Vit-Buckle Society's 2020 virtual meeting, Nika Bagheri, MD, delivered an insightful presentation on practice-building recommendations for new vitreoretinal surgeons. In her talk, Dr. Bagheri suggested a number of pearls, ranging from the knowledge new associates need to ascertain (practice-specific systems, the referral landscape, partner strengths, knowing your staff), to actionable items (having face-to-face meetings with referring providers, covering all emergencies from said providers, and being available to do so), to attitudes new associates need to maintain (balancing patient expectations, surviving poor reviews, and remembering that even young associates bring something to the table).

Kyle D. Kovacs, MD: You are more than 2 years into your practice development. How have you shifted your practice-building mentality from day 1 to today?

Nika Bagheri, MD: I think that we perform best when we have a fluid and flexible approach, but practice building never ends, and certain principles are key to follow whether it is your first day on the job or your 20th year in practice. Namely, the three A's: Be *available*, *affable*, and *able*. Every referring doctor experience, from a simple phone call to a dictated letter, is an opportunity to demonstrate to your community that you are a AAA-certified physician, so to speak.

Dr. Kovacs: In your VBS presentation, you touched on one of the hardest balancing acts for young practitioners: doing what patients *want* versus providing what patients *need*. What tips or tricks do you have for new associates?

Dr. Bagheri: The vast majority of patients simply want to feel that they are cared for, respected, and safe in trusting

a competent physician. I like to set expectations early and review exam findings in detail at the end. Always try to frame things in an appropriate way to give reassurance where it's warranted, without minimizing the reason the patient came in. Having spiels for diagnosis, prognosis, and treatment of common retina conditions is extremely helpful to maximize patient confidence in you as a provider.

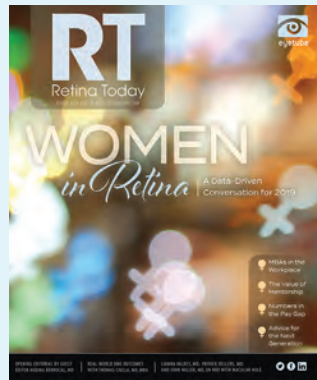
Dr. Kovacs: Did you ever feel that being the first female in a previously all-male group changed the practice-building landscape for you?

Dr. Bagheri: In my experience, people tend to like people that they are similar to or they identify with. Referring doctors and patients will end up gravitating toward certain providers over others. This is just one of the many reasons why physician diversity is so critical to maintain a healthy long-term practice.

Dr. Kovacs: What specific suggestions do you have for engaging with your referral base in the COVID-19 world?

More from Dr. Bagheri

Read Dr. Bagheri's thoughts about joining California Retina Consultants in "Starting Off as the First Female Physician in an All-Male Practice: Ten Tips," from our March 2019 issue at bit.ly/Bagheri1020.



Dr. Bagheri: I believe that a case-by-case approach is best in today's environment. Every referring provider will have slightly different expectations and preferences about social distancing,

in-person meetings versus virtual meetings, etc. As such, it is better to be conservative when unsure and to ask questions before presuming. Although a face-to-face meeting may not be possible, your voice in a direct conversation and your availability make a huge difference. COVID-19 has perhaps accelerated an already growing movement away from traditional strategies for building a referral base. Generally speaking, the younger generation of referring providers is comfortable with texting, calling, and virtual formats. ■

NIKA BAGHERI, MD

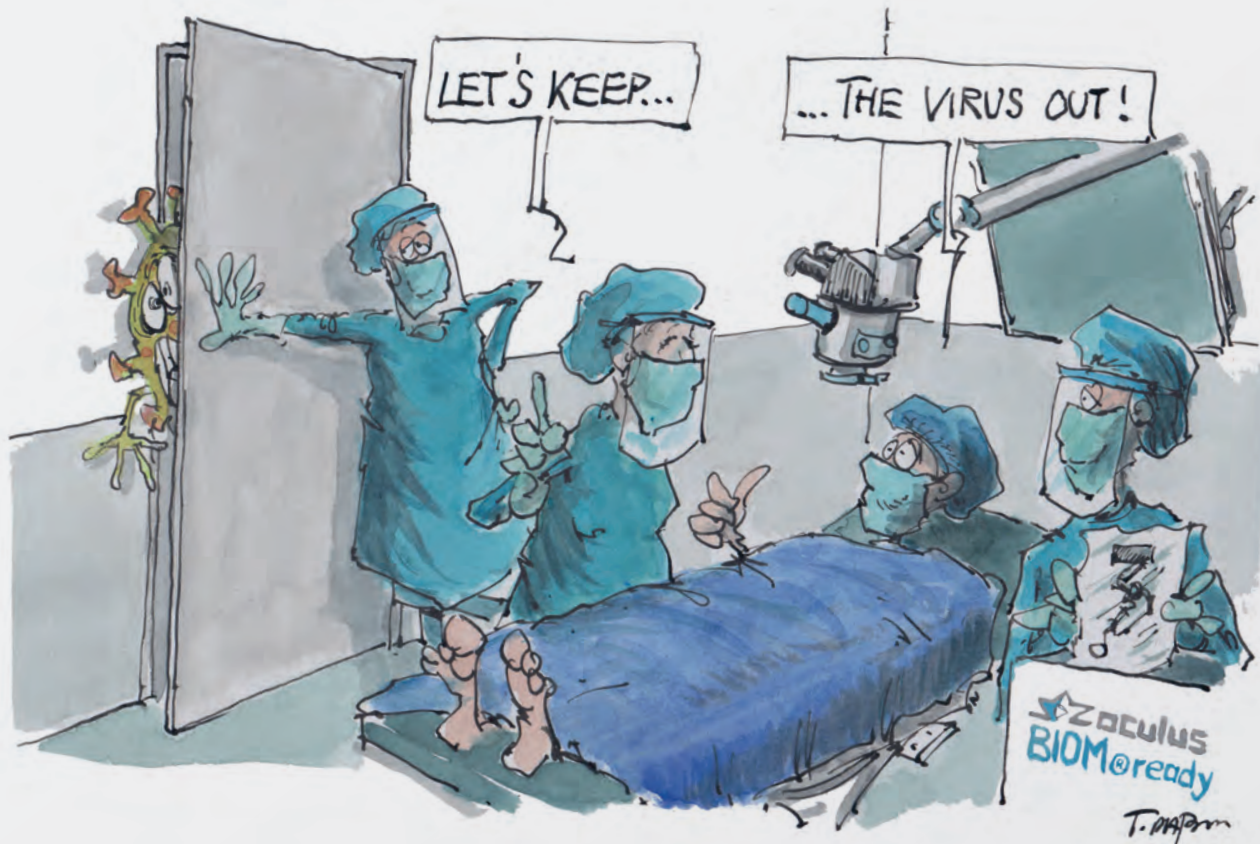
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Vitreectomy Without Intravenous Anesthesia



Taking a cue from our anterior segment colleagues.

BY ERICA PODESTO, BA, AND MURTAZA ADAM, MD

Pars plana vitrectomy (PPV) is typically performed with the assistance of an anesthesiologist either with monitored anesthesia care (MAC) or general anesthesia (GA), combined with a local ocular block. Numerous factors, including the patient's medical history, comorbidities, anxiety, dementia, medication or illicit drug history, along with surgical complexity, expected case time, and language barriers, can all influence the anesthesia modality selected for a particular case. For all cases supported by an anesthesiologist, patients are required to fast for at least 8 hours before surgery, and intravenous (IV) line placement is mandatory. With local block administration and anesthesiologist support, PPV with this approach has a proven track record of patient comfort and safety.

While vitreoretinal surgeons have been performing cases with the same anesthesia approach for decades, our anterior segment colleagues have been rapidly evolving their approaches to anesthesia for cataract surgeries. Recent studies involving cataract surgery with topical anesthesia and oral sedation without an anesthesiologist have reported excellent outcomes with reduced costs, low intraoperative complication rates, and increased patient satisfaction.¹⁻³

Aside from the benefits of not requiring IV line placement or fasting preoperatively, additional financial costs related to the care provided by an anesthesiologist are deferred with this technique. These significant cost reductions are of greatest benefit for patients with high deductible insurance plans and those without insurance. Insurers have not ignored these financial benefits. Indeed, Anthem Blue Cross in California proposed a policy that limited ophthalmic anesthesia coverage to local and topical regional anesthesia, specifically stating that it would not cover MAC sedation,

asserting that MAC was not medically necessary in most circumstances.^{4,5} Despite the subsequent retraction of this policy by Anthem, many anterior segment surgeons across the country choose to perform their surgeries without intravenous sedation because the benefits to both patients and payers are significant.

Can we retina surgeons learn from our anterior segment colleagues when it comes to anesthesia approaches for PPV? Although vitreoretinal cases likely cannot achieve the efficiency and comfort of a 5-minute cataract surgery with topical anesthesia, we believe that PPV can be safely and comfortably performed without IV anesthesia for a significant proportion of patients. In this article we share our rationale and methodology for, and our initial experience with, a technique to perform PPV without IV sedation.

AT A GLANCE

- ▶ Although cataract surgery anesthesia techniques have evolved in recent decades, anesthesia for vitreoretinal surgery has remained mostly static.
- ▶ With appropriate patient and case selection, PPV without IV anesthesia has the potential to reduce costs, improve patient satisfaction, decrease OR turnover time, and increase the feasibility of in-office PPV.
- ▶ The authors describe a technique for sub-Tenon block without anesthesiology support that has to date been employed successfully in a mix of vitreoretinal surgeries.

A SUB-TENON BLOCK CAN BE SAFELY AND COMFORTABLY ADMINISTERED TO A CONSCIOUS PATIENT WITHOUT THE USE OF PROPOFOL. AFTER I GAINED SIGNIFICANT EXPERIENCE WITH THIS MINIMALIST ANESTHETIC TECHNIQUE, THE TRANSITION TO PERFORMING PPV WITHOUT IV SEDATION WAS RELATIVELY SEAMLESS.

WHY SHIFT THE PARADIGM?

In the United States, PPV is most commonly performed with MAC anesthesia and an intraconal or retrobulbar block to achieve local akinesia and anesthesia, requiring sharp needle penetration through the orbital septum.⁶ Other local anesthesia options exist, however, including periorbital block, sub-Tenon block, and subconjunctival anesthesia. For most surgeons performing a local block, regardless of method, the block is immediately preceded by the administration of IV propofol provided by an anesthesiologist to sedate the patient.⁷

Although propofol and other IV sedatives such as fentanyl and midazolam are standard of care for anesthesiologists providing support for PPV, these drugs introduce risks such as hypotension, apneic spells and sudden movement upon their resolution, cardiovascular compromise, respiratory depression, metabolic acidosis, acute kidney injury, and nausea.⁸ Additional complications related to retrobulbar and peribulbar techniques include retrobulbar hemorrhage, orbital perforation, injection of the perioptic meningeal space causing respiratory suppression, optic nerve damage, lid hematoma, vascular retinal occlusion, and diplopia secondary to myotoxicity.⁹ Block effectiveness with these techniques can also be variable, and supplemental IV anesthesia may be needed intraoperatively, increasing the risk of additional complications.

Aside from the risks listed above, patients who are more heavily sedated at the beginning of a case do not easily follow instructions and can suddenly awaken with confusion. This can lead to unexpected and rapid movement of hands and head. When one is peeling a membrane off the macula, this can be a scary experience.

With these issues in mind, I (M.A.) began performing sub-Tenon blocks with minimal IV anesthesia, typically with midazolam and occasionally fentanyl. There has been an increase in the use of sub-Tenon compared to retrobulbar and periorbital techniques in vitreoretinal surgery in the past few years, presumably because of the improved safety profile and equivalent efficacy compared to traditional peribulbar and retrobulbar anesthesia.¹⁰ Furthermore, a sub-Tenon block can

be safely and comfortably administered to a conscious patient without the use of propofol. After I gained significant experience with this minimalist anesthetic technique, the transition to performing PPV without IV sedation was relatively seamless.

The first time I performed PPV without IV sedation was in 2018 for a patient who was undergoing urgent retinal detachment (RD) repair. He was frustrated to learn that he would need to find a ride home after surgery because of the delayed effects of IV sedation. After some discussion, I offered to perform the surgery without sedation with a sub-Tenon block. The patient agreed, as he would then be able to drive himself home postoperatively. He had a comfortable experience during surgery and the case was performed without issue. After this experience, I began offering PPV without anesthesiologist support for patients without insurance, those out of network or with or high-deductible plans, those with difficult IV access, and patients wary of fasting for surgical cases booked in the afternoon.

Oral sedatives have a higher safety profile compared with IV sedatives because they require lower dosages to achieve sedation. Thus, they are safer to use in patients with high anesthesia risk.

Furthermore, surgical costs for anesthesia management with IV sedation and MAC are relatively more expensive.¹¹ The surgeon and patient should evaluate the risks and benefits of each option to select the most appropriate option for the individual patient.

TECHNIQUE AND CASE SELECTION

For most patients, the technique involves using a sub-Tenon block with oral or no sedation and performing vitrectomy without the support of an anesthesiologist. For those receiving oral sedation, I borrowed the method of a cataract surgeon colleague and administered 0.125 to 0.25 mg of triazolam 30 minutes before the surgery, based on body mass index. Intraoperative vital signs including heart rate, blood pressure, oxygen, and respiratory rate were monitored by the circulating OR nurse.

Before block administration, the operative eye receives proparacaine drops for topical anesthesia and is then

prepped and draped with standard sterile technique using 5% povidone-iodine. After a lid speculum is placed with the patient still conscious, a small conjunctival incision is made in the inferonasal quadrant with Wescott scissors. A 19-gauge blunt sub-Tenon cannula is then gently inserted into the sub-Tenon space via this conjunctival incision, and approximately 5 to 6 mL of the anesthetic containing a 1:1 mixture of lidocaine and bupivacaine is administered.

When the anesthetic is injected slowly over a period of approximately 20 to 30 seconds, patient comfort is maintained. This is truly the most critical portion of the technique. If the block is administered too quickly, patient discomfort can be significant. If needed, additional sub-Tenon block can be administered subsequently via the previously created inferonasal conjunctival incision.

Ideally, surgical cases with this technique should not last more than 60 minutes. The technique should also be avoided in patients with significant anxiety and claustrophobia, patients requiring scleral buckle placement, and complex cases in which operative time is difficult to predict. Other exclusions are patients who have experienced delirium after anesthesia with benzodiazepines and those with illicit drug or heavy alcohol use.

OUTCOMES

Since September of 2018, I have performed 21 PPVs using this method. Patients who opted for this method had insurance issues (uninsured or out of network; $n = 11$), preferred IV-free sedation ($n = 6$), were unable to fast ($n = 1$), had difficult IV access ($n = 1$), or were considered high anesthesia risk ($n = 2$). Indications for surgery included macular hole, dislocated or mispositioned IOL, aphakia, vitreous hemorrhage, RD (both rhegmatogenous and diabetic tractional detachment), retained lens fragments following cataract surgery, and retained silicone oil tamponade. Most cases ($n = 14$) were performed with oral sedation, and the others ($n = 7$) were performed with no sedation.

Intraoperative complications, need to cease surgery mid-operation, or conversion to intravenous sedation were not encountered. One patient required additional supplemental sub-Tenon block intraoperatively.

With a mean follow-up time of 76 ± 86 days (range 1–345 days), mean visual acuity significantly improved, from a mean preoperative VA of 1.15 ± 0.74 LogMAR to a mean 0.59 ± 0.52 logMAR ($P = .023$) postoperatively. Postoperative complications included recurrent RD ($n = 1$), cystoid macular edema ($n = 1$), vitreous hemorrhage ($n = 2$), corneal edema ($n = 1$), postoperative glaucoma ($n = 1$), and postoperative cataract ($n = 1$).

Overall, we found that patients were satisfied with their surgical experience and visual outcomes. This assertion is supported by the fact that the same method of anesthesia was requested by four patients who underwent reoperation either

on the same eye or the fellow eye. We also found that patients were grateful that they could eat and drink until the time of their surgery and that IV placement was not required.

LOOKING AHEAD

Taking a cue from our anterior segment colleagues, I have found that PPV can be safely and effectively performed without the support of an anesthesiologist. We plan to continue collecting data and have begun offering IV-free PPV to patients more routinely, regardless of insurance status. We are also designing an unmasked randomized prospective trial to compare oral to IV sedation for patients undergoing PPV. We expect this study to supplement the ongoing masked randomized clinical study at Boston University that is comparing oral triazolam to IV midazolam in a variety of ocular surgeries, including vitreoretinal surgery.¹²

With appropriate patient and case selection, PPV without IV anesthesia has clear potential to reduce costs, improve patient satisfaction, decrease OR turnover time, and increase the feasibility of in-office PPV. With time, we expect this technique to be adopted by more vitreoretinal specialists looking for better ways to care for their surgical patients. ■

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Facedown or Not Facedown?



A brief review of literature on positioning after macular hole surgery.

BY JESSICA RANDOLPH, MD, AND ELISSE PARK, MD

Postoperative positioning after macular hole (MH) surgery has been controversial. The position of the head postoperatively is significant because of the mechanics of intraocular gas tamponades, which aid in sealing a MH after removal of the internal limiting membrane. Facedown posturing (FDP) is recommended by many vitreoretinal surgeons so that the gas bubble can be apposed to the MH for a sustained time period. This is thought to improve the chance that the hole will close and heal. Prone positioning, however, can be uncomfortable, inconvenient, and at times not possible for the patient.

The subject is controversial because there is disagreement over whether or not positioning improves outcomes. This article presents summaries of a sampling of recent publications on this issue.

Comparison of face-down posturing with nonsupine posturing after macular hole surgery: a meta-analysis.

Xia S, Zhao X, Wang E, et al¹

In this meta-analysis, the authors reviewed papers that compared strict FDP with nonsupine posturing (NSP) after MH surgery. The meta-analysis included 11 studies including a cumulative 742 surgeries, with 396 patients in the FDP group and 346 patients in the NSP group. The pooled results showed that the MH closure rate for all surgeries was higher in the FDP group (odds ratio [OR] 1.828, 95% CI 1.063-3.143, $P = .029$). For MHs that were greater than 400 μm , the OR was even higher, at 4.361 (95% CI 1.429-13.305, $P = .01$).

The study suggests that adhering to strict FDP could improve MH closure rate; however, the authors note, patient compliance with FDP is often difficult. Notably, this study did not consider postoperative visual acuity.

No face-down positioning surgery for the repair of chronic idiopathic macular holes.

Elborgy E, Starr M, Kotowski J, et al²

This retrospective study examined MHs with a duration greater than 1 year, performed by a single surgeon at the Mayo Clinic in Rochester, New York. The study included 18 eyes of 18 patients with chronic idiopathic MHs. The mean MH duration was 5.0 ± 6.9 years. Postoperatively, all patients were instructed to maintain a face-forward, eye-forward head position for 1 hour and then, after each subsequent hour, maintain a face-forward, eye-down position for 15 minutes. Patients were also instructed to avoid sleeping on their back. These positions were recommended for the first 3 to 5 days after surgery. Patients were evaluated for MH closure by slit-lamp biomicroscopy and spectral-domain OCT. All OCTs were analyzed by one researcher to avoid interobserver variation. MH closure was achieved in 17 of 18 (94.4%) eyes. The authors concluded that NSP may be noninferior to FDP.

AT A GLANCE

- There is disagreement regarding whether facedown positioning improves outcomes in macular hole surgery.
- The authors recap the findings of several recent publications on this topic.
- Several studies suggest that strict prone positioning may not be necessary after macular hole repair.



Figure. Observational adherence assessment. Patients were evaluated seven times a day, at 00:00, 03:00, 06:00, 10:00, 14:00, 19:00, and 21:00, for 3 days. In the FDP group (top panel), the patient passed the assessment only if the patient adhered to FDP. In the NSP group (lower panel), the patient failed only if the patient faced upward.

Macular hole surgery recovery with and without face-down posturing: a meta-analysis of randomized controlled trials.

Ye T, Yu J, Liao L, et al³

This meta-analysis included randomized controlled trials up to January 2019 that compared surgeries with postoperative FDP versus those with NSP, and performance of intraoperative internal limiting membrane (ILM) peeling was required. The final analysis comprised five trials including 358 total eyes. The MH closure rate was higher in the FDP group (OR 2.27, 95% CI 1.02-5.05, $P = .04$). Subgroup analysis showed a significant difference in closure rate for holes larger than 400 μm , but not for those smaller than 400 μm . The authors note that in larger holes “the distance between the broken ends of the retina is so large” that, even after traction is relieved with vitrectomy and ILM peeling, “it requires a strict prone position to ensure that the gas bubble, under a sufficient or partial absorption state, keeps the intraocular gas-macula contact extended, drawing the edges of the hole into apposition with each other, thus providing a scaffold for the migration of glial cells, blocking fluid entry into the hole and moving the subretinal fluid to reattach the retina.” In contrast, smaller holes may require only gas tamponade to achieve successful anatomic healing.

Facedown positioning after vitrectomy will not facilitate macular hole closure based on swept-source optical coherence tomography imaging in gas-filled eyes: a prospective, randomized comparative interventional study.

Yong Z, Xiao C, Lin H, et al⁴

This study was one of the few randomized controlled trials completed recently about the topic in question. The trial included 80 eyes that underwent vitrectomy, ILM peeling, and gas tamponade. Patients were treated as inpatients to allow close monitoring. Forty eyes maintained FDP while the other 40 were allowed NSP. At postoperative visits, closure of MHs was confirmed by OCT. At postoperative days 1, 2, and 3, there

was no significant difference in the percentage of patients with MH closure between the two groups ($P = .84-.97$). By 2 weeks postoperative, MH closure was confirmed by OCT in 90% of eyes in the FDP group and 92.5% in the NSP group ($P = .91$). At 3 months postoperative, none of the holes that closed had reopened. Additionally, there was no significant difference in improvement in BCVA between the two groups at 1 month ($P = .22$) and at 3 months ($P = .45$).

The results of the study suggest that FDP may not be required to facilitate either faster hole closure or improved visual acuity. Taken together with the results of the other studies described above, it may be concluded that strict prone positioning may not be necessary after MH repair.

Adherence to face-down and non-supine positioning after macular hole surgery.

Morimoto E, Shimada Y, Sugimoto M, et al⁵

This study compared the rate of adherence to the prescribed postoperative positioning in patients who underwent MH repair and were hospitalized at a university hospital in Japan. One subset of patients was instructed to maintain FDP for 3 days, and the other was instructed to maintain FDP for 3 hours and then switch to NSP for 3 days. Patients were evaluated by nursing staff seven times per day to check for adherence (Figure). Among 92 total patients, the mean adherence rate of $99.3\% \pm 2.7\%$ in the NSP group was significantly higher than that in the FDP group ($93.7\% \pm 1.3\%$; $P < .001$). MH closure was achieved in all 92 (100%) patients.

Although it cannot be concluded that NSP will always result in the same outcome as FDP, the authors note that NSP is easier to comply with and may result in a favorable outcome comparable to that with FDP. ■

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The Cost Efficiency of Miotics Use in Ophthalmic Surgeries



A survey suggests that many surgeons are unaware of differences between two commonly used drugs.

BY SEPEHR BAHADORANI, MD, PHD; CHELSEY KRAMBEER, MD; SHIRA BLANCHETTE, MBA; DANIEL A. JOHNSON, MD; CALVIN MEIN, MD; MICHAEL A. SINGER, MD; AND JEONGHYEON SOHN, MD

Acetylcholine chloride intraocular solution (Miochol-E, Bausch + Lomb) and carbachol intraocular solution 0.01% (Miostat, Alcon) are parasympathomimetic medications used during ophthalmic surgeries to induce miosis and after cataract surgery to reduce IOP spikes.¹

Acetylcholine is a naturally occurring neurotransmitter that mediates direct parasympathomimetic effects at cholinergic receptors, after which it is rapidly degraded by the acetylcholinesterase enzyme.² Carbachol, in addition to direct binding to receptors, can also induce indirect parasympathomimetic effects by inhibition of the acetylcholinesterase enzyme. Hence, in comparison with acetylcholine, which has a very short duration of action, carbachol has a longer duration of action, up to 24 hours after intraocular administration.^{3,4}

Given the differences in durations of action, it is not surprising that carbachol has been shown to be the better pharmacologic agent for controlling IOP after extracapsular cataract surgery.¹ Acetylcholine, on the other hand, might be preferred by some anterior segment surgeons due to its rapid onset of effect, as may be needed in complex cases such as a penetrating keratoplasty triple procedure or Descemet-stripping automated endothelial keratoplasty.

Although both of these drugs have been used in ophthalmic surgeries for decades, many ophthalmologists may be unaware of the differences between the two drugs in mechanism and duration of action, as well as their relative

costs. We performed a cost analysis and a knowledge survey to better understand current preferences in the use of these medications.

COST ANALYSIS AND SURVEY

In our cost analysis, we evaluated the cost per unit, total cost, and frequency of use of these two medications at our surgery center.

Of those we invited to participate in a survey on Survey Monkey, 102 retina specialists responded. The survey questions were as follows:

1. How frequently do you use Miochol or Miostat for your surgeries?

AT A GLANCE

- ▶ According to a survey, many retina specialists do not understand the differences between acetylcholine chloride intraocular solution (Miochol-E, Bausch + Lomb) and carbachol intraocular solution 0.01% (Miostat, Alcon).
- ▶ A cost analysis reveals that switching to carbachol could save retina practices a significant amount of money.

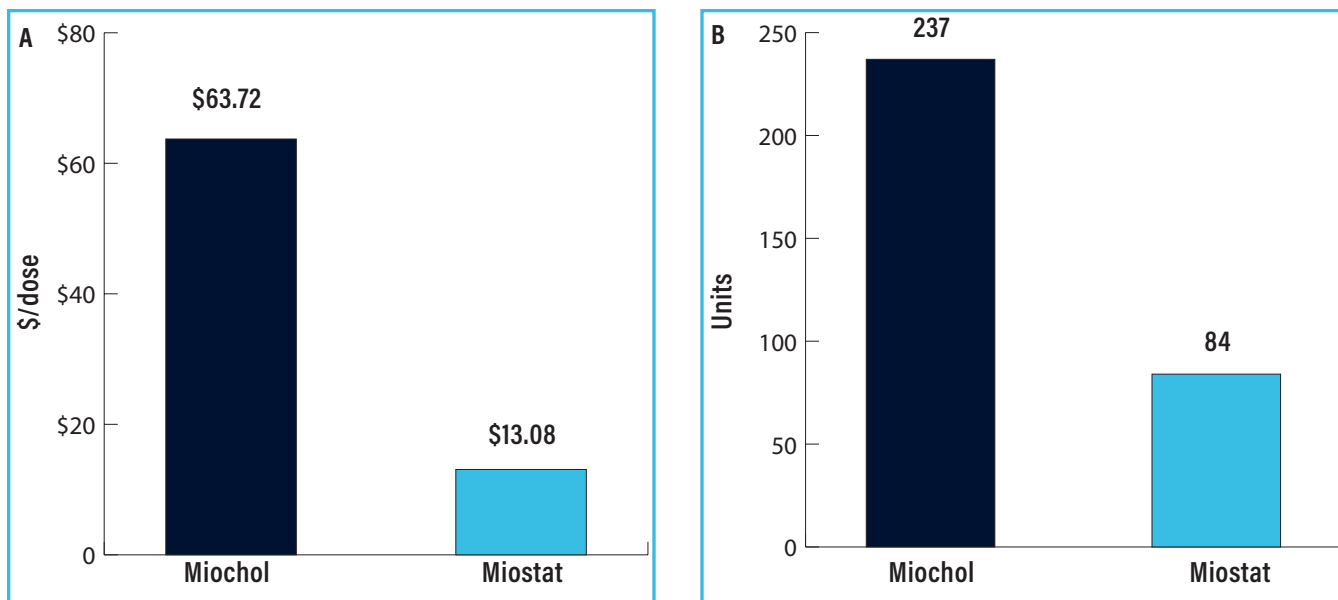


Figure 1. The price per unit (A) and frequency of medication use in one surgery center over a 12-month period (B).

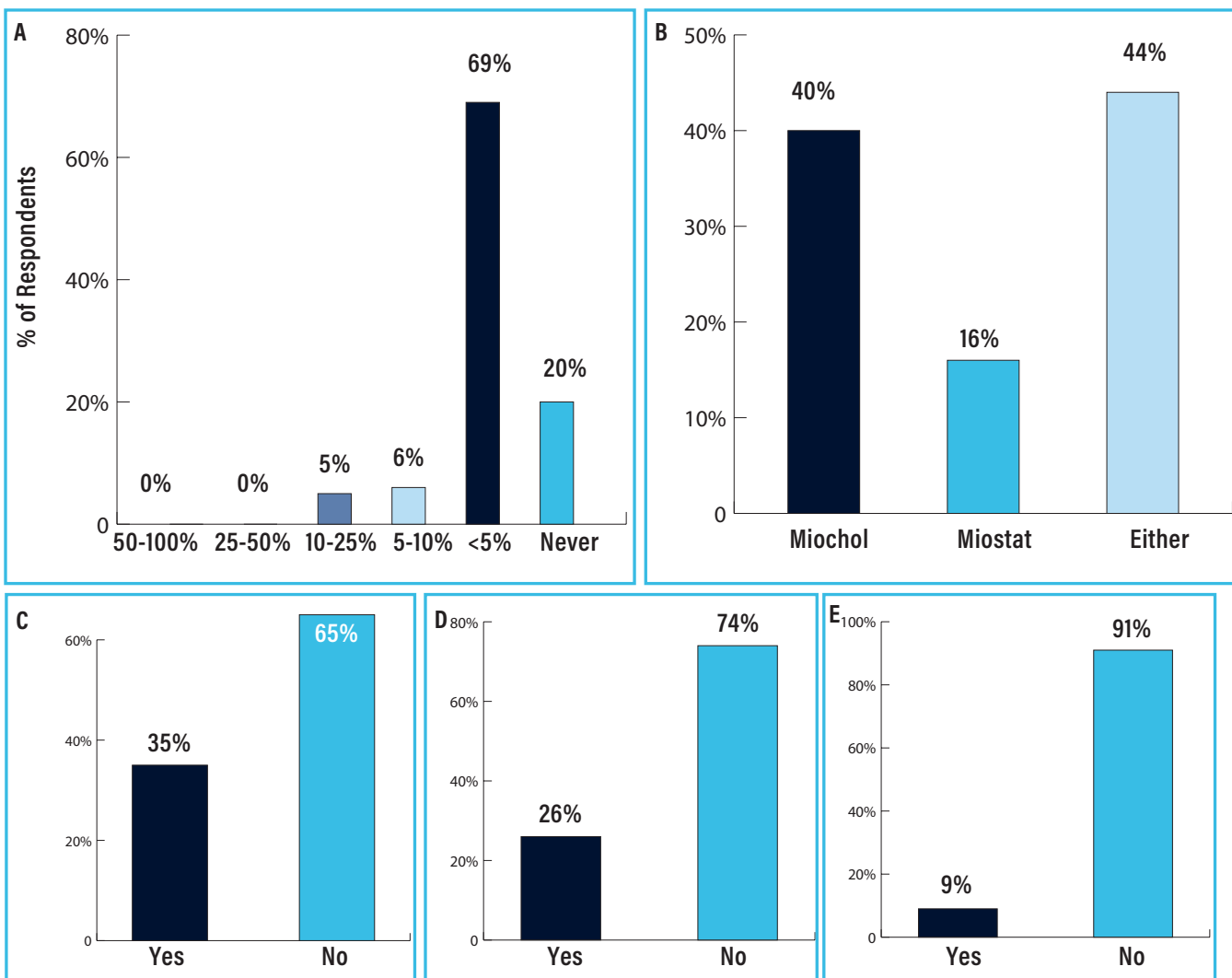


Figure 2. Survey results for 102 respondents. Frequency of medication use during surgeries (A); preference for medication (B); and knowledge regarding duration of action (C), mechanism of action (D), and cost difference between the two drugs (E).

2. Which of the following medications do you preferably use?
3. Are you familiar with the difference in exact mechanism of action between Miochol and Miostat?
4. Are you familiar with the difference in the duration of action between Miochol and Miostat?
5. Do you know the price difference between Miochol and Miostat?

RESULTS AND DISCUSSION

Our cost analysis found that Miochol is more expensive than Miostat, with costs per unit of \$63.72 and \$13.08, respectively (Figure 1A). Consequently, despite infrequent use of these medications, a considerable amount of money could be saved by switching from Miochol to Miostat.

The survey results for 102 respondents (Figure 2) indicated that 69% of respondents use these miotic medications in less than 5% of their surgeries; 40% expressed preference toward Miochol, 16% toward Miostat, and 44% expressed no preference for either option. The survey also found that 65%, 74%, and 91% of respondents were unaware of the differences in the duration of action, mechanism of action, and cost between these medications, respectively.

Despite its lower cost and longer duration of action, only 16% of respondents expressed a preference for Miostat. At our surgery center, a total of 237 units of Miochol were purchased in 1 year, with cost per unit of \$63.72, compared with 84 units of Miostat with cost per unit of \$13.08 (Figure 1B). We calculate that a complete switch from Miochol to Miostat would have saved our surgery center an estimated \$11,000 in that 1 year.

CONCLUSION

Carbachol is a less expensive medication with a longer duration of action compared with acetylcholine. Nevertheless, in response to our survey, most retina specialists said they prefer acetylcholine as their medication of choice, despite its higher price and shorter duration of action in comparison with carbachol.

This preference is likely due to a lack of awareness regarding differences in the cost and efficacy of these two miotic medications. By switching from acetylcholine to carbachol, our facility—and surely many other retina facilities nationwide—could save a considerable sum of money in the costs per case for a variety of ophthalmic procedures. ■

The authors wish to note that the content of their study was IRB exempt, according to their office of the institutional review board.

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Vitrectomy for Retained Lens Fragments: Outcomes and Prognostic Factors



Real-world outcomes of vitrectomy for one of the most common complications after cataract surgery.

BY ERROL CHAN, MBBS, FRCOPHTH, FRCSC, AND LOUISA WICKHAM, MD

We (E.C. and L.W.) were recently among the coauthors of a study seeking to understand prognostic factors for and visual outcomes of 23-gauge microincision vitrectomy surgery for retained lens fragments after complicated cataract surgery. This article summarizes some of the salient findings of the resulting recently published paper.¹

Although it is relatively uncommon for dislocated lens fragments to fall into the vitreous cavity, this event nevertheless remains a key complication of phacoemulsification surgery.²⁻⁴

Pars plana vitrectomy (PPV) surgery, first described by Machemer in 1973,⁵ can be accomplished with small-gauge instrumentation in the modern era. PPV is often used to manage retained lens fragments after cataract surgery. We had several questions regarding PPV for retained lens fragments:

What are modern real-world outcomes of microincision PPV? Many major studies on PPV for retained lens fragments have been based on 20-gauge systems, which many surgeons no longer use.⁶⁻¹¹ We sought to understand if innovations in phacoemulsification and anterior vitrectomy technologies correlated with better outcomes.

What role does timing play in outcomes? We sought to understand the relationship between outcomes and the interval between primary cataract surgery and PPV.

Can a risk profile be established? We wanted to know if baseline patient characteristics could guide clinical and surgical management of these patients.

STUDY DESIGN

We aimed to analyze real-world data regarding visual outcomes and to identify independent prognostic determinants of these outcomes in patients who underwent PPV for dropped lens fragments with 23-gauge instrumentation.

We performed a retrospective, interventional case series that reviewed electronic health records from 291 consecutive patients (291 eyes) with retained lens fragments after cataract surgery. Patients were seen from 2012 to 2017 at Moorfields Eye Hospital in London, United Kingdom. We gathered preoperative cataract surgery data

AT A GLANCE

- An analysis of real-world visual outcomes data of small-gauge vitrectomy performed for retained lens fragments following cataract surgery was performed.
- At 6 months, 62.9% of patients had BCVA of 20/40 or better, and 15.5% of patients had worse than 20/200 BCVA.
- Vitrectomy may be safely delayed by up to 2 weeks without risking poorer visual outcomes.

and intraoperative and postoperative vitrectomy data, including BCVA measurements.

All patients received topical steroids and antiglaucoma medications before PPV, and surgeons could administer topical sodium chloride 5% at their discretion.

Cases were reviewed within 2 days of the primary cataract surgery. If corneal clarity was determined to be sufficient, PPV was performed. Patients with insufficient corneal clarity due to stromal or IOP-related microcystic edema had their cases reassessed every 2 days for up to 2 weeks to determine the earliest possible time that PPV surgery could be safely performed.

Surgery

All vitrectomies were performed with a 23-gauge, three-port PPV system (Constellation Vision System, Alcon). Corneal de-epithelialization was performed if deemed necessary to improve intraoperative view. Before retained lens fragments were addressed, posterior vitreous detachment was initiated and a posterior vitrectomy was performed in the usual fashion. Surgeons used the 23-gauge cutter to address lens fragments. A 20-gauge phacofragmatome was used for large fragments, if needed. Surgeons conducted a 360° depressed search and treated retinal breaks as detected.

IOL placement occurred during cataract surgery, during PPV, or during a subsequent surgery. If a surgeon determined that a patient's visual outcome would be poor after IOL implantation, the eye was left aphakic.

Outcome measures

The study's primary outcome was the proportion of eyes that achieved 20/40 BCVA or better at 6 months and 20/200 BCVA or worse at 6 months. The nature and incidence of complications were secondary outcomes.

Univariate and multivariate logistic regression analyses were used to characterize all pre-, intra-, and

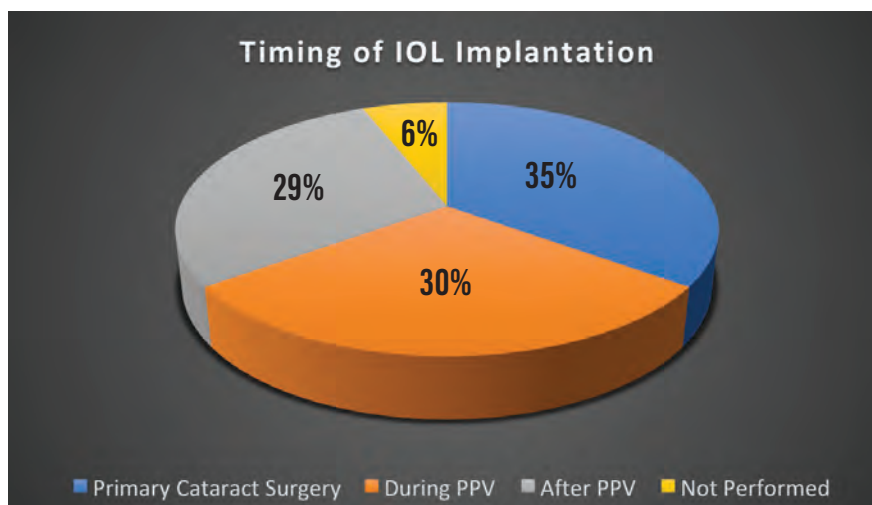


Figure. In most cases, IOL implantation was performed during primary cataract surgery. IOL implantation during or after PPV occurred at nearly the same rates.

postvitrectomy factors associated with achieving at least 20/40 BCVA or worse than 20/200 BCVA at 6 months.

RESULTS

LogMAR BCVA improved from 0.73 ($\pm$ 0.70) before cataract surgery to 0.46 ($\pm$ 0.63) after vitrectomy. This difference was statistically significant ($P < .001$).

Previtrectomy logMAR BCVA was 1.43 ($\pm$ 0.79). At 6 months, 183 (62.9%) patients achieved BCVA of at least 20/40, and 45 (15.5%) patients achieved BCVA worse than 20/200.

We found that retained lens fragments were caused by posterior capsular rupture in 264 eyes (90.7%); in the other 27 eyes (9.2%), zonular dehiscence was the cause of retained lens fragments. Among all eyes, 55 (18.9%) demonstrated at least one type of retinal pathology, and 32 eyes (11%) had preexisting glaucoma.

Of the 291 eyes, 290 underwent PPV when the cornea was deemed clear enough for surgery. Only one eye underwent PPV for uncontrolled IOP. Photofragmentation with 20-gauge instrumentation was performed in 176 eyes (63.9%).

IOL implantation was performed during primary cataract surgery in 35% of cases, during PPV in 30% of cases,

and after PPV in 29% of cases. In 6% of cases, it was not performed at all (Figure). The most frequent post-PPV complications were de novo ocular hypertension (29 eyes, 10%) and transient cystoid macular edema (CME; 25 eyes, 8.6%). Retinal detachment occurred in nine eyes (3.1%).

Visual Results

Our team found that final BCVA of 20/40 or better was independently associated with four factors: better visual acuity before cataract surgery, age less than 75 years, the absence of preexisting diabetic macular edema, and the absence of postvitrectomy persistent CME ($P < .05$). We found that final VA of 20/200 or worse was associated with poorer precataract surgery visual acuity, vitrectomy delayed more than 2 weeks, and final aphakic status ($P < .05$).

INTERPRETATION

These visual outcomes do not represent an improvement compared with earlier large cohorts of predominantly 20-gauge PPV for retained lens fragments. These outcomes also appear poorer than established benchmarks after uncomplicated cataract surgery.

The reasons why the visual outcomes based on microincision

vitrectomy do not represent an improvement from earlier predominantly 20-gauge cohorts are unclear, as we did not have access to the raw data of the earlier studies we used as a basis for comparison.

Nevertheless, the lower rate of post-PPV retinal detachment and macular edema in this study group underscores that smaller-gauge surgery has a better safety profile overall than 20-gauge surgery in those earlier studies. This apparently improved safety did not seem to translate into better visual outcomes, suggesting that other vision-determining factors are in play. Such factors may include the profile of other visual comorbidities of the patients involved in our study.

We also detected four patients with macular holes occurring after PPV. This condition has not been previously described. We hypothesize that this may have occurred from unregulated ultrasound energy from the phacofragmatome port, or during PPV induction.

Our multivariate analysis also showed that neither the timing of IOL implantation nor the location of the IOL itself (capsular bag, sulcus, or anterior chamber) influenced visual outcomes. Poorer visual outcomes were, however, associated with delays in PPV of more than 2 weeks and the development of post-PPV persistent CME.

Patients in this study were scheduled for PPV based on a common institutional protocol using corneal clarity as the main arbiter for PPV timing. To some extent, a common practice pattern can overcome some of the inconsistencies encountered with multiple studies having different thresholds for PPV. In a meta-analysis, Vanner et al found a general trend toward better visual outcomes with earlier vitrectomy.¹² Modi et al showed no difference in visual outcomes when PPV was performed within the same day, within a week, or more than a week after PPV.⁶

In our study, PPV delayed by more than 2 weeks due to suboptimal

corneal clarity was associated with poorer visual outcome. At the molecular level, this may be due to the upregulation of proinflammatory cytokines during this time, which may result in poorer outcomes. Although it may seem wiser to perform PPV as soon as possible, it may often be difficult to do so because of the poorer intraoperative view.

A second potentially modifiable variable affecting visual outcome is the development of persistent postoperative CME. It is difficult to fully understand whether there was initially uncontrolled inflammation in the eyes in our series following cataract surgery. However, in the postvitrectomy period, inflammation and CME were monitored and treated with an escalating paradigm based on topical NSAIDs, topical steroids, and sub-Tenon triamcinolone injection. In eyes with capsular ruptures and zonular dehiscence, there are concerns about use of an intravitreal dexamethasone implant 0.7 mg (Ozurdex, Allergan) because of possible migration to the anterior segment. Perhaps earlier treatment of inflammation, such as delivery of sub-Tenon steroids after primary cataract surgery, may mitigate early postoperative inflammatory drive and decrease the likelihood of CME.

This study is retrospective in nature, which may have introduced selection bias. Other ophthalmologist-determined factors such as nucleus size, perception of corneal clarity, extent of anterior uveitis, or IOP level, could also factor into the threshold for PPV.

CONCLUSION

Some readers may be surprised to find that, in this series, microincision innovation in surgical instrumentation did not appear to be associated with improved visual outcomes. Nevertheless, there was an overall better safety profile of small-gauge surgery, in terms of a lower risk of retinal detachment and postvitrectomy macular edema. The study data do

provide some empirical evidence that performing PPV as soon as corneal clarity permits, and within 2 weeks of cataract surgery, as well as measures to prevent post-PPV CME, may be helpful in achieving better visual outcomes. ■

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Live-Streaming From the OR Using a Plug-and-Play Device



An inexpensive device could lead to improvements in surgical education.

BY EDWARD S. LU, BA; JOHN B. MILLER, MD; S.K. STEVEN HOUSTON III, MD; AND JOHN W. KITCHENS, MD

The COVID-19 pandemic has highlighted the possibility of using telemedicine in ophthalmology to limit in-person visits and prioritize the safety of our patients and staff members.^{1,2} With many elective operations canceled or postponed, educational conferences and didactics transitioning from in-person to virtual, and reductions of nonessential personnel in the OR, there is a need to adapt and improve the surgical curriculum of clinical fellows, residents, and medical students.³⁻⁵ Video-based education, virtual didactics, and virtual simulation are some of the components that can be employed in a multipronged approach to redesigning surgical education.⁶ Other innovative solutions include implementing a flipped virtual classroom model, providing online practice questions, and engaging residents in telehealth clinics.⁷

Hands-on learning in the OR cannot be replaced, of course, but technological advancements in hardware, software, and transmission capabilities make telesurgery a promising tool to improve virtual surgical education.

Previously in *Retina Today* we have discussed the benefits of transitioning to a heads-up 3D surgical platform (Ngenuity Visualization System, Alcon) and the use of a 5G cellular network to broadcast high quality vitreoretinal surgery to a remote location.^{8,9} In this article, we explore the potential value of telesurgery in improving the educational experience of clinical trainees. We present our experience with a user-friendly, off-the-shelf video capture device that enables clinicians to seamlessly

livestream surgeries from the OR. We review how to capture, transmit, and view live surgery using this plug-and-play solution in an effort to enhance surgical education.

BASIC SETUP Video Capture

The Magewell USB Capture HDMI 4K Plus (Figure) is an inexpensive, commercially available (\$459 on Amazon.com) plug-and-play device that enables transfer of 4K resolution video from an HDMI source to a computer for livestreaming. We have been using the input source in the OR from the Ngenuity 3D surgical platform connected to the Magewell device, with output of surgical video to a

AT A GLANCE

- ▶ New uses of telemedicine have emerged during the COVID-19 pandemic.
- ▶ A plug-and-play device can be used to stream live video from the OR to a distant audience of fellows, residents, and medical students.
- ▶ The technology could also be used to offer consultation to surgeons in areas with limited access to specialty care.

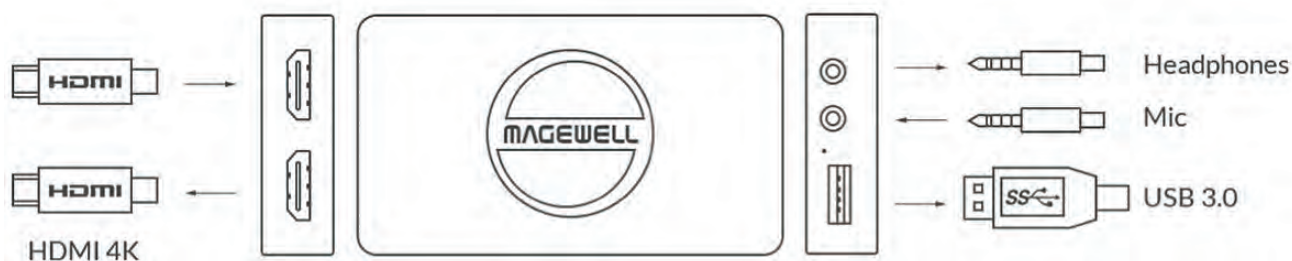


Figure. Design of the Magewell device used in the OR. Source: Magewell.

MacBook Pro. The device is compatible with Windows, Linux, Mac, and Chrome OS operating systems.

The Magewell interface features input resolution up to 4,096 x 2,160 pixels, loop-through HDMI signal, and audio input via microphone, and extraction of HDMI embedded audio output via headphones. The device is compact (5.4 x 5.3 x 1 in), light (8 oz) and can function continuously for 24 hours, 7 days a week, without an external fan or other cooling mechanism, as it has a built-in cooling fan.

Transmission

Two-dimensional or 3D video (using Ngenuity) can be transmitted using open-source software such as OBS or commonly used platforms such as Zoom, YouTube, and Facebook Live to broadcast live surgery. We have been piloting the use of Zoom to transmit vitreoretinal surgical cases to viewers in several states in the United States and in other countries.

Zoom has the benefit of allowing real-time discussion during surgery. Zoom provides high level end-to-end encryption with AES 256 GCM transport encryption for an added level of privacy and security.

We have also explored the use of YouTube Live private channels to allow multiple viewers to attend live surgery channels; however, latency on YouTube varies from 10 to 30 seconds, thus precluding real-time discussion.

Other supported software that can record or transmit 4K video captured by the Magewell device includes VLC,

vMix, and XSplit. Video processing features of the system include cropping, scaling, deinterlacing, aspect ratio conversion, and color format conversion, allowing a high degree of video editing if desired.

Viewing

Viewing options include 2D and 3D, depending on video transmission type and viewing hardware and software. The Magewell device supports extraction of 3D format information, including side-by-side (SBS), top-and-bottom, and frame-packing (single frame) 3D modes.

Viewers can use a desktop or laptop computer to watch 2D video or choose a 3D viewing experience on a desktop or laptop by using video software conversion to Anaglyph 3D combined with compatible 3D glasses. In addition, 3D SBS video can be viewed on a low-cost virtual reality headset with mobile phone insertion.

VARIED USES

The Magewell video streaming device can be used in a variety of settings. Live broadcasting of surgeries can offer surgical training to a widespread audience of remote trainees. As noted, viewing platforms such as Zoom allow surgeons to discuss important aspects of the case, and trainees have the ability to ask questions in real time. In addition, the surgeon's view with superimposed instrument settings of the Ngenuity can be made visible to the audience.

Live video streaming can also be used for telementoring, to provide

surgical expertise and remote consultation to geographic areas without access to specialty surgical care. A pyramid structure, whereby an expert retina surgeon is on call to provide assistance to multiple junior surgeons operating in remote locations, could be used to improve access to specialized surgical care for difficult cases and improve surgical outcomes.

Furthermore, use of this video capture technology may offer a practical tool to address disparities in global surgery by improving surgical education.¹⁰ An anterior segment colleague, Kevin M. Barber, MD, has demonstrated success using the Magewell device and our protocol to train cataract surgeons in Honduras with real-time communication. Thus, this plug-and-play technology has the potential to democratize access to specialty surgical care and education on a global scale.

FUTURE DIRECTIONS

The Magewell video capture device offers a simple solution to live-streaming vitreoretinal surgery with applications in surgical education, telementoring, and remote consultation, on both a local and global level.

Robotic ophthalmologic surgery is still in its nascency, but the use of robotic assistance and smart instruments has the potential to improve the precision and safety of vitreoretinal surgery.¹¹ Livestreaming of robotic surgery may become an important tool to teach novel surgical approaches to trainees while allowing feedback and discussion.

With the growth of video-based and virtual education, imagine a future in which trainees can tune in live to cases from across the globe based on their individual learning needs and preferences. With telesurgery expanding access to expert surgical education, in the future, surgeons will be able to gather more surgical knowledge and virtual experience before entering the OR in person. ■

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CONVENTION UPDATES

Some ophthalmology meetings in 2020/2021 have changed direction. Others are staying the course—for now. This list is accurate as of *Retina Today's* press date in mid October.

GOING VIRTUAL

DUKE FELLOWS ADVANCED VITREOUS SURGERY COURSE

Duke Eye Center

Remaining Streaming Dates:

- October 22, 2020: Session 3 — Life Beyond Fellowship

More Information at: [MedConfs.com](https://www.medconfs.com)

30TH ANNUAL RONALD G. MICHELS FELLOWSHIP FOUNDATION MEETING

October 26, 2020

More Information at: [MedConfs.com](https://www.medconfs.com)

AAO ANNUAL MEETING: RETINA SUBSPECIALTY DAY

November 13, 2020

More Information at: aao.org/annual-meeting

AAO ANNUAL MEETING: UVEITIS SUBSPECIALTY DAY

November 13, 2020

More Information at: aao.org/annual-meeting

AAO ANNUAL MEETING

November 13-15, 2020

More Information at: aao.org/annual-meeting

21ST ANNUAL RETINA FELLOWS FORUM

Three Streaming Dates:

- January 26, 2021: Session 1

- January 28, 2021: Session 2

- January 31, 2021: Session 3

More Information at: [MedConfs.com](https://www.medconfs.com)

ANGIOGENESIS, EXUDATION, AND DEGENERATION 2021

Miami, Florida

February 12-13, 2021

More Information at: [UMiamiHealth.org](https://www.UMiamiHealth.org)

CANCELED

AMERICAN UVEITIS SOCIETY WINTER SYMPOSIUM

Park City, Utah

PROCEEDING AS PLANNED

ASPEN RETINAL DETACHMENT SOCIETY

Snowmass, Colorado

March 6-10, 2021

More Information at: [MedConfs.com](https://www.medconfs.com)

VIT-BUCKLE SOCIETY ANNUAL MEETING

Las Vegas, Nevada

April 8-10, 2021

More Information at: [MedConfs.com](https://www.medconfs.com)

DUKE FELLOWS ADVANCED VITREOUS SURGERY COURSE

Durham, North Carolina

April 15, 2021

More Information at: [MedConfs.com](https://www.medconfs.com)

RESCHEDULED

EURETINA WINTER MEETING

Original Date:: March 20-21, 2020

New Date: February 26-27, 2021

More Information at: euretina.org/vilnius2020

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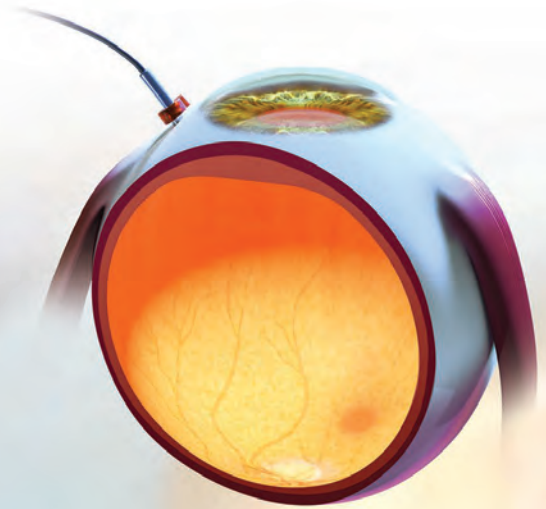


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