scribed by Spaide et al.¹ Using this technique, we have noted that the characteristic peripapillary lesions may be associated with choroidal thickening with or without hyporeflective areas of cavitation (Figure 1, Figure 2, and video [http://www.archophthalmol.com]). We reaffirm the findings of Toranzo and colleagues; however, we propose the term peripapillary choroidal thickening and cavitation to more accurately reflect a spectrum of optical coherence tomographic findings associated with this lesion.

K. Bailey Freund, MD
Sri Krishna Mukkamala, MD
Michael J. Cooney, MD

Author Affiliations: Vitreous Retina Macula Consultants of New York (Drs Freund and Cooney), Department of Ophthalmology, New York University (Drs Freund and Cooney), and The New York Eye and Ear Infirmary (Dr Mukkamala), New York.

Correspondence: Dr Freund, Vitreous Retina Macula Consultants of New York, 460 Park Ave, Fifth Floor, New York, NY 10022 (kbfnyf@aol.com).

Financial Disclosure: None reported.

Funding/Support: This work was supported by The Macula Foundation, Inc, New York, New York.


Frequency of Intraocular Pressure Increase Within Days After Intravitreal Triamcinolone Injections in the Diabetic Retinopathy Clinical Research Network

In a previously published randomized trial comparing intravitreal triamcinolone acetonide to focal/grid photocoagulation for diabetic macular edema,¹ the Diabetic Retinopathy Clinical Research Network (DRCR.net) measured intraocular pressure (IOP) 4±3 days (referred to as the 4-day visit) after study participants assigned to the triamcinolone arm underwent an intravitreal injection. These data provide the opportunity to evaluate the frequency of IOP increase within a few days following an intravitreal triamcinolone injection.

Methods. In the aforementioned randomized trial, IOP was measured at the 4-day visit after each injection of 1 mg or 4 mg of triamcinolone acetonide (Trivaris). From the IOP measurements at this visit, we determined the frequency of an IOP event, defined as an increase from the preinjection IOP of more than 10 mm Hg to an IOP of 30 mm Hg or greater.

Results. Rates of IOP events assessed 1 to 7 days after injections are shown in the Table. Of the 3 eyes (0.6%) with IOP events following the baseline injection, all were treated with IOP-lowering medication after the event and had an IOP lower than 30 mm Hg at the last available study visit, although 1 eye (in the 1-mg group) was still taking IOP-lowering medication. Of the 12 eyes (3%) that had IOP events following multiple injections, 11 were treated with IOP-lowering drugs. All but one (in the 4-mg group) were controlled, with IOPs lower than 30 mm Hg by the last available study visit, although 3 of the 11 (1 in the 1-mg group and 2 in the 4-mg group) were still taking IOP-lowering medication at the last visit. Of note, there were 74 postbaseline injections for which an eye was already receiving IOP-lowering medication during the corresponding 4-day visit, and IOP events were observed in 2 (3%) of these cases (both in the 4-mg group). A flowchart detailing all of the IOP events, including the preinjection and postinjection IOPs, use of IOP-lowering medication, and resolution of each event, are shown in the Figure.

Comment. Immediately after intravitreal injection, volume expansion causes an expected IOP elevation that is typically transient, with IOP normalization usually occurring within 30 minutes.²³ Steroid-induced IOP elevation is a well-described phenomenon that has been reported to occur typically a few weeks after exposure to corticosteroids.⁴⁻⁶ Detection of a substantial IOP increase at the 4-day postinjection visit in a few study participants in this study was unexpected and, to our knowledge, previously unreported. The reasons for elevated IOP in this time frame are unclear. There were no reports of triamcinolone detected in the anterior segment of these eyes.

The IOP was not measured 1 to 7 days after the initial treatment visit in the 330 laser-treated eyes; however, none of these eyes met IOP event criteria at the 4-month study visit. Whether an increase in IOP 1 to 7 days after the injection is related to the injection alone or to the steroid can-

<table>
<thead>
<tr>
<th>Triamcinolone Acetonide Injection Dosage</th>
<th>Baseline Visit, Initial Injection</th>
<th>4-mo Visit</th>
<th>8-mo Visit</th>
<th>12-mo Visit</th>
<th>At Any Follow-up Visit, Subsequent Injections</th>
<th>At Any Visit, Initial or Subsequent Injections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mg</td>
<td>2/249 (0.8)</td>
<td>1/168 (2)</td>
<td>2/114 (2)</td>
<td>0/89 (0)</td>
<td>4/546 (0.7)</td>
<td>6/795 (0.7)</td>
</tr>
<tr>
<td>4 mg</td>
<td>1/244 (0.4)</td>
<td>2/116 (0.9)</td>
<td>3/105 (3)</td>
<td>1/79 (1)</td>
<td>8/471 (2)</td>
<td>9/715 (1)</td>
</tr>
</tbody>
</table>

*Intraocular pressure event is defined as a 4-day postinjection visit intraocular pressure of 30 mm Hg or higher that also increased 10 mm Hg or more from the preinjection intraocular pressure.
not be determined from this study. However, of the 5 eyes that had an event following a baseline or 4-month injection, only 1 eye had documentation of any long-term sequelae, specifically, taking IOP-lowering medications beyond the 1-year visit (1 other study participant [1 eye] did not return for the 4-month or any subsequent visits, and 3 eyes had an IOP <30 mm Hg and were not taking any IOP-lowering medications). It is scientifically interesting that IOP occasionally increased within 1 to 7 days of intravitreal steroid injection as study criteria excluded those patients who might be at risk for developing IOP problems following intravitreal steroid injection. Patients with IOP 25 mm Hg or higher, neovascular glaucoma, history of open-angle glaucoma, or history of steroid-induced glaucoma were excluded from entering the study. However, the low risk of this IOP increase and the lack of evidence of long-term clinical harm from delay in diagnosis do not seem sufficient to justify routine assessment of patients within 1 to 7 days of injection in patients with our study characteristics.

Author Affiliations: Casey Eye Institute, Oregon Health and Science University, Portland (Dr Lauer); Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, Maryland (Dr Bressler); and Jaeb Center for Health Research, Tampa, Florida (Ms Edwards).

Correspondence: Ms Edwards, c/o Jaeb Center for Health Research, 15310 Amberly Dr, Ste 350, Tampa, FL 33647 (dcrstat1@jaeb.org).

Group Information: A list of the Diabetic Retinopathy Clinical Research Network (DRCR.net) investigators and staff participating in this protocol was published in Ophthalmology. 2008;115(9):1447-1449, 1449.e1-1449.e10, and a current list appears at http://www.dcr.net.

Financial Disclosure: A complete list of all DCRR.net investigator financial disclosures can be found at http://www.drrc.net.

Funding/Support: This work was supported through a cooperative agreement from the National Eye Institute and the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, US Department of Health and Human Services (grants EY14231, EY018817, and EY14229). Allergan, Inc provided the triamcinolone and topical antibiotics after successfully completing the 1-year visit for a request for proposals issued by DRCR.net for a company to provide a preservative-free triamcinolone.

Figure. Flowchart detailing all intraocular pressure (IOP) events. A IOP event is defined as a 4-day postinjection visit IOP of 30 mm Hg or higher that also increased 10 mm Hg or more from the preinjection IOP. The preinjection IOPs (measured the day of the offending injection) were 16 and 21 mm Hg; the postinjection IOP was 21 mm Hg (missing for 1); 1 eye was phakic at the time of the offending injection; and neither eye had a history of ocular hypertension at baseline. One eye had 2 IOP events: 1 event following the initial injection and 1 event following a subsequent injection 4 months later. The preinjection IOP (measured the day of the offending injection) was 18 mm Hg; the postinjection IOP was missing; the eye was phakic at the time of the offending injection; and the eye did not have a history of ocular hypertension at baseline. The preinjection IOPs (measured within 1 week before the offending injection) were 15, 16, 16, and 19 mm Hg; the postinjection IOPs (measured the day of the offending injection) were 23 and 40 mm Hg (missing for 2); and 2 eyes were phakic at the time of the offending injection. The preinjection IOPs (measured within 1 week before the offending injection, with the exception of 1 measured 22 days prior to injection) were 14, 16, 19, 19, 20, 20, 21, and 21 mm Hg; the postinjection IOPs (measured the day of the offending injection) were 17, 28, 28, 32, and 32 (missing for 3); 5 eyes were phakic at the time of the offending injection; and 1 eye had a cataract extraction on the day of the injection. Not resolved is defined as an IOP 30 mm Hg or higher or receiving an IOP-lowering medication at the last available study visit; resolved is defined as an IOP lower than 30 mm Hg and not receiving IOP-lowering medication at the last available study visit.
lone for the study. Allergan, Inc has provided unrestricted funds to DRCR.net for its discretionary use. **Role of the Sponsor:** The funding organization participated in oversight of the conduct of the study and review of the manuscript but not directly in the design of the study, the conduct of the study, data collection, data management, data analysis, interpretation of the data, or preparation of the manuscript. As per the DRCR.net Industry Collaboration Guidelines (http://www.drcr.net), DRCR.net had complete control over the design of the protocol, ownership of the data, and all editorial content of presentations and publications related to the protocol.


**Selective Abnormality of Cone Outer Segment Tip Line in Acute Zonal Occult Outer Retinopathy as Observed by Spectral-Domain Optical Coherence Tomography**

Optical coherence tomography (OCT) plays an important role in the diagnosis of retinal diseases with minimal ophthalmoscopic changes. For example, in eyes with acute zonal occult outer retinopathy (AZOOR), 1,3 an abnormality of the photoreceptor inner segment–outer segment (IS/OS) junction found by OCT was spatially correlated with the region of visual field defect. Recent high-resolution spectral-domain OCT images have shown a thin line between the IS/OS junction and the retinal pigment epithelium. This line has been identified as the cone OS tip (COST) line. 6 However, the pathophysiological interpretation of its appearance has not been established, and the diagnostic value of the COST line has yet to be determined.

We report 2 cases of AZOOR, both of which showed acute central scotoma with an enlarged blind spot. The ophthalmoscopic and angiographic changes were minimal, but electoretinography (ERG) revealed reduced responses in the affected regions. In both cases, the IS/OS junction on the OCT image was normal, but the COST line was not present or appeared indistinct in the region of visual field defect. Our findings suggest that the COST line may be an early indicator of cone photoreceptor dysfunction in eyes with minimal ophthalmoscopic abnormalities.

**Report of Cases.** Patient 1 (a 24-year-old woman) and patient 2 (a 28-year-old woman) both had sudden unilateral visual disturbances following photopsia. The visual acuities were 0.02 OD and 1.5 OS in patient 1 and 0.15 OD and 1.5 OS in patient 2. Goldmann kinetic perimetry revealed a blind spot enlargement and central scotoma in the right eye of both patients (Figure 1 and Figure 2). The anterior segment and fundus were normal; however, fluorescein angiography showed a slightly mottled hyperfluorescence around the macula in the affected eye of both patients. The full-field scotopic ERGs were normal, but there were phase delays in the photopic 30-Hz ERGs in the affected eyes: 5.7 milliseconds in patient 1 and 8.0 milliseconds in patient 2. In addition, the amplitudes of the photopic b-waves were reduced in both patients. The focal macular ERGs (ER80; Kowa Co, Tokyo, Japan, and Mayo Co, Nagoya, Japan) in the central 15° were almost flat in the affected eye in both patients. Neither patient had systemic disorders such as viral infections or autoimmune diseases.

Spectral-domain OCT (Carl Zeiss Meditec, Dublin, California) showed the IS/OS junction clearly, even in the region of the scotoma. However, the COST line was not detected in patient 1 and appeared indistinct in patient 2. Furthermore, the COST line was always absent in the affected eyes. The visual disturbances of these patients did not recover, and these abnormalities in the OCT images were observed at all examinations for 50 months in patient 1 and 18 months in patient 2 after the onset.

**Comment.** To our knowledge, this is the first report of AZOOR where the boundary of the IS/OS junction in the OCT images was well preserved but the COST line was absent or indistinct from the initial examination through the entire follow-up period. Earlier studies demonstrated that a loss or irregularity of the IS/OS junction observed by OCT corresponded well with the visual field defects even at the early stages of AZOOR, 2,3 and the abnormality in the IS/OS junction can improve following recovery of the scotoma. These findings have led to the hypothesis that photoreceptor OS dysfunction is the primary lesion in AZOOR.

The COST line corresponds to the junction between the photoreceptor tips and the apical processes of the retinal pigment epithelium, where photoreceptor OS disc membranes are continuously shed for renewal. 8 Thus, the appearance of the COST line may reflect the normal function of the photoreceptor OSs more closely than the IS/OS junction. In fact, in all of the AZOOR cases we have recently examined, the COST line was always absent in the region of IS/OS abnormalities, suggesting that the abnormality of the COST line may precede that of the IS/OS junction. In our 2 cases, the fundus appeared normal and the IS/OS junction was clearly observed in the region of the COST line abnormality for 50 and 18 months after the onset. The focal macular ERGs, however, were markedly reduced in the affected areas. In the OCT images, the cone photoreceptor dysfunction corresponding to the region of scotoma could be detected only by the abnormality of the COST line.

**COST line.**