optic was exposed to UV light over an extended period, whereas the peripheral optic may be protected by the iris. In the present case, the lesions characteristic of snowflake degeneration were restricted to the central 2 mm of the lens optic in the dry state. This is the smallest area we have ever observed and may be related to the fact that the patient's pupils were relatively constricted as noted on the examination before and after dilation. This fact presumably supports the hypothesis that snowflake changes are facilitated by UV light.

For the first time, to our knowledge, a lens explanted because of snowflake degeneration was analyzed in the dry and hydrated states. The snowflake lesions per se are dry lesions and should be differentiated from glistenings. Glistenings are fluid-filled vacuoles and were largely described in association with hydrophobic acrylic lenses but can also be associated with other materials, including PMMA.3,4 On hydration of the explanted lens described herein, we did not observe the formation of small vacuoles throughout the lens optic, as seen with glistenings. An unusual amount of water was collected within the central 4 mm of the lens optic, where multiple linear cracks were present. These cracks were not evident under light microscopy in the dry state. They may represent the initial injury before the typical snowflake lesions are seen or they may be secondary to the initial presence of the more central snowflake lesions. In any case, the clinical significance of snowflake degeneration may depend on the amount of water collected within the area of cracks.

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Octreotide as a Treatment for Uveitic Cystoid Macular Edema

Cystoid macular edema (CME) is the most frequent cause of irreversible blindness and visual impairment in patients with uveitis.1 There is no consensus on the most effective treatment for uveitis-associated CME; many agents are used with variable responses. Because there is a constant release of inflammatory mediators that can disturb retinal pigment epithelial function in active uveitis, the first and most important step is to control the uveitis. In addition, CME can be treated with conventional options, including corticosteroid agents administered topically, by pericocular or intraocular injection, or orally; nonsteroidal anti-inflammatory drugs administered orally or topically in aphakic eyes; and carboxy anhydrase inhibitors. Additional treatment methods such as hyperbaric oxygen, pars plana vitrectomy, and laser grid photocoagulation are more controversial treatments. Despite aggressive treatment, CME frequently progresses.

Octreotide is a somatostatin analogue. It is an even more potent inhibitor of the release of growth hormone and other hormones than somatostatin is, and it is used for the treatment of acromegaly, carcinoid tumors, and vasoactive intestinal polypeptide-secreting tumors. Studies have shown that somatostatin is also synthesized in the retina, and, furthermore, its receptors sst1, sst2, and sst5 are present in retinal pigment epithelial cells and other parts of the human retina.2,3 Based on published evidence demonstrating the efficacy of octreotide in treating macular edema from other causes, we explored its use in 5 patients with uveitic CME refractory to conventional treatment.

Methods. This investigation was approved by the Human Research Committee of Massachusetts Eye and Ear Infirmary, Boston. After discussing the risks and benefits, informed consent was obtained from the patients.

Five patients (9 eyes) received treatment. All patients had longstanding (≥6 mo) CME secondary to uveitis, which persisted after clinically evident control of the inflammation with immunomodulatory therapy. Furthermore, the macular edema did not respond to additional treatment with corticosteroid agents (systemic, peribulbar, or intraocular), oral nonsteroidal anti-inflammatory agents, and acetazolamide.

All patients were given octreotide acetate (Sandostatin; Novartis Pharmaceuticals Corp, East Hanover, NJ), 100 µg injected subcutaneously 3 times daily. In 3 patients, treatment was switched to a long-acting depot formulation of octreotide acetate (Sandostatin LAR Depot; Novartis Pharmaceuticals Corp), administered as a monthly 20-mg intragluteal injection.

The course of macular edema was monitored with clinical examination, fluorescein angiography, and optical coherence tomography (OCT-1 or OCT-3; Carl Zeiss Meditec Inc, Dublin, Calif). Additional data on age, sex, previous treatments, Snellen visual acuity, duration of octreotide treatment, and adverse effects were recorded.

Results. All 5 patients were women aged 24 to 61 years. One had unilateral CME; 4 had bilateral CME. The uveitis was idiopathic in 2 patients, and was associated with sarcoidosis in another 2 patients and with the HLA-B27 gene in 1 patient. In all patients, immunomodulatory therapy had resulted in clinical remission of the inflammation. The agents used were methotrexate, azathioprine, cyclophosphamide, or mycophenolate mofetil as monotherapy or combined with intravenous immunoglobulin. Conventional treatment for CME failed either because the edema was resistant or recurrent or because of adverse effects (patients 1 and 3 had acetazolamide intolerance). Cor-

Ticosteroid agents were not used for at least 1 month before treatment with octreotide. The patients were followed up at regular intervals. The mean time between the onset of treatment with octreotide and the last follow-up visit was 12.4 months (range, 7-24 months). Octreotide treatment resulted in marked improvement or complete resolution of CME in 7 of 9 eyes (Figure 1 and Figure 2). The CME in 2 eyes (patient 2) did not respond to this treatment. Best-corrected Snellen visual acuity at the last visit before octreotide treatment ranged from 20/25 to 20/200. Visual acuity recorded at the last visit was better in all 7 eyes that exhibited improvement in CME (Table). No patient experienced adverse effects from octreotide administration.

Comment. The first clinical use of octreotide for treating CME was reported by Kuijpers et al\(^4\) in 1998 in a patient with idiopathic macular edema. In 2004, Hernaez-Ortega et al\(^5\) reported the beneficial effect of octreotide treatment in a patient with diabetic macular edema. Van Hagen et al\(^2\) in a review article, reported their positive experience in treating uveitic CME, according to their unpublished observations.

The exact mechanism of macular edema reversal by octreotide treatment is unknown. The following possible mechanisms have been proposed:

1. There is direct action of octreotide on retinal pigment epithelial cells; activation of \(sst\) receptors stimulates ion and water transport systems;
2. Somatostatin receptors in retinal vessel endothelium mediate antiproliferative effects, helping to restore the inner blood-retinal barrier; and
3. Improvement of the neuroretinal function by the aforementioned 2 mechanisms may contribute to improved visual acuity; and
4. Somatostatin and its analogues have a suppressive effect on the immune response; subsequent decreased inflammation reduces CME associated with uveitis.

In our study, CME in 7 of 9 eyes responded well to octreotide treatment. All of our patients had extremely resistant and chronic edema, which renders their positive response to octreotide treatment more notable.

Improvement in the visual acuity in these 7 eyes was observed as well. Cataract surgery with intraocular lens implantation was performed on the right eye of patient 3, which in combination with the resolution of the CME accounted for the increased vision. Despite the marked improvement or complete resolution of the edema, as visualized at clinical examination, fluorescein angiography, and optical coherence tomography, visual acuity improved only slightly, probably because of the irreversible retinal damage produced as a result of the chronicity of the edema. The most common adverse events associated with octreotide administration are gastrointestinal tract disturbance within the first few days of treatment and cholecystitis with long-term treatment. Octreotide should not be used in children or pregnant women because it inhibits growth hormone. In our study, no adverse effects were observed and, apart from the inconvenience of the frequent injections that the subcutaneous form required, all patients tolerated the drug well.

The efficacy of octreotide in our patient sample suggests that it may
be a viable option for treating uveitic CME. Further clinical research is required to develop adequate safety and efficacy information.

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Figure 2. Patient 5, right eye. A, Cystoid macular edema is demonstrated at optical coherence tomography at the last visit before treatment with octreotide (macular thickness, 654 µm). Optical coherence tomography shows improvement of the edema after 1 month of treatment (macular thickness, 490 µm) (B) and complete resolution after 3 months of treatment, which was maintained at the 8-month follow-up visit (macular thickness, 210 µm) (C).

<table>
<thead>
<tr>
<th>Patient No./Age, y</th>
<th>Cause of CME</th>
<th>Affected Eye</th>
<th>Previous Treatment</th>
<th>Duration of Octreotide Treatment, mo</th>
<th>Initial BCVA</th>
<th>logMAR Equivalent</th>
<th>Most Recent BCVA</th>
<th>logMAR Equivalent</th>
<th>VA Rate of Change, logMAR Change, mo</th>
<th>Foveal Thickness, µm</th>
<th>Decrease in Thickness, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/57</td>
<td>Idiopathic</td>
<td>OD, OS</td>
<td>NSAIDs, acetazolamide, corticosteroids, IMT</td>
<td>24</td>
<td>20/100, 20/200</td>
<td>−0.70, −1.00</td>
<td>20/50, 20/60</td>
<td>−0.40, −0.48</td>
<td>0.01, 0.02</td>
<td>No OCT, No OCT</td>
<td>654, 210</td>
</tr>
<tr>
<td>2/59</td>
<td>Sarcoid</td>
<td>OD, OS</td>
<td>NSAIDs, corticosteroids, IMT</td>
<td>7</td>
<td>20/40, 20/25</td>
<td>−0.30, −0.10</td>
<td>20/40, 20/30</td>
<td>−0.30, −0.18</td>
<td>0.00, −0.01</td>
<td>427, 283</td>
<td>409, 290</td>
</tr>
<tr>
<td>3/61</td>
<td>Sarcoid</td>
<td>OD, OS</td>
<td>NSAIDs, acetazolamide, corticosteroids, IMT</td>
<td>12</td>
<td>20/400, 20/50</td>
<td>−1.30, −0.40</td>
<td>20/60, 20/30</td>
<td>−0.48, −0.18</td>
<td>0.07, 0.02</td>
<td>351, 540</td>
<td>232, 201</td>
</tr>
<tr>
<td>4/24</td>
<td>Idiopathic</td>
<td>OD</td>
<td>Acetazolamide, corticosteroids, IMT, IVIG</td>
<td>11</td>
<td>20/320, 20/125</td>
<td>−1.20, −0.80</td>
<td>20/70, 20/25</td>
<td>−0.54, −0.10</td>
<td>0.06, 0.06</td>
<td>586, 653</td>
<td>199, 144</td>
</tr>
<tr>
<td>5/39</td>
<td>HLA-B27</td>
<td>OD</td>
<td>NSAIDs, acetazolamide, corticosteroids, IMT</td>
<td>8</td>
<td>20/150</td>
<td>−0.88</td>
<td>20/60</td>
<td>−0.48</td>
<td>0.05</td>
<td>654, 210</td>
<td>240.7</td>
</tr>
</tbody>
</table>

Mean 12.4 0.03 496.2 240.7 39.3

Table. Patient Data

Abbreviations: BCVA, best-corrected Snellen visual acuity; CME, cystoid macular edema; IMT, immunomodulatory therapy; IVIG, intravenous immunoglobulin; logMAR, logarithm of the minimum angle of resolution; NA, not applicable; NSAIDs, nonsteroidal anti-inflammatory drugs; OCT, optical coherence tomography; OD, right eye; OS, left eye; VA, visual acuity.