tient’s visual acuity was 20/200, and although the majority of the cornea was nonedematous, there was marked corneal edema in the area of the GV markings with bulla noted (Figure 1). Over several weeks, the edema gradually resolved with interface haze in the area of prior edema. The visual acuity resolved to 20/40 without correction.

Case 2. A 67-year-old woman with a history of Fuchs endothelial dystrophy presented with gradual onset of blurry vision of the right eye. On examination, it was found that her best-corrected visual acuity was 20/60 in the right eye and 20/30 in the left eye. There was 3+ guttata with 1+ edema of the right eye. There was a well-centered posterior chamber intraocular lens on the right. His left eye had 1+ guttata and a 1+ nuclear sclerotic cataract. An uneventful DSAEK was performed (thickness of graft unknown).

On postoperative day 1, the graft was fully attached, there was 2+ diffuse corneal edema present, and her visual acuity was 3/200. The edema was most prominent in the area of the purple markings (Figure 2). At postoperative week 1, the patient’s visual acuity was unchanged. Interface haze was noted at the area of the markings. At the 2-week postoperative visit, her visual acuity was 20/400, and her best-corrected visual acuity was 20/80. No change occurred 1 month after surgery. At postoperative week 6, the patient had a best-corrected visual acuity of 20/40 with a clear cornea.

Comment. Using a rabbit model, Chang et al illustrated that endothelial cells are destroyed via the effects of the dye. We presume that the eventual improvement of the edema over time with gradual visual rehabilitation results from the compensatory measures of the surrounding unaffected cells. Current best practice dictates that a surgeon preserve as many endothelial cells as possible during DSAEK. Given the novelty of DSAEK, we do not know the natural history of a DSAEK graft in terms of longevity. However, if one applies the same logic as that used for a penetrating keratoplasty, the reasonable conclusion is to presume that more endothelial cells will result in a better chance for long-term graft survival. The findings behind this case report are limited given the sample size. However, given the data in the previously reported studies, in conjunction with our clinical observations, we recommend that the use of GV (including the dose and duration of exposure) on donor grafts be limited as much as possible because of concern over irreversible damage to the corneal endothelium.

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Lagophthalmos in Severe Anorexia Nervosa: A Case Series

Anorexia nervosa is characterized in the Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition) by (1) a refusal to maintain a minimally normal body weight (eg, a body weight of <85% of expected body weight or a body mass index [BMI]; calculated as weight in kilo-
grams divided by height in meters squared] of <17.5), (2) an intense fear of gaining weight, (3) a disturbance in the evaluation of one's own body shape, and (4) amenorrhea. Anorexia nervosa has the highest mortality of any psychiatric illness and has a lifetime estimated prevalence of 0.9% in women and 0.3% in men, with a standardized mortality ratio of 45 for patients whose lifetime nadir BMI is less than 10.5.2,3 A subset of patients with anorexia nervosa develop such severe disease that they require medical hospitalization for stabilization before they are able to be admitted to traditional eating disorder programs. The ACUTE Center for Eating Disorders at Denver Health in Colorado is an inpatient unit with multidisciplinary expertise in caring for such critically ill patients.

We describe 5 patients with severe anorexia nervosa who were admitted to the ACUTE Center and who complained of dry, irritated eyes and photophobia. Examination revealed lagophthalmos in the setting of enophthalmos and pseudoptosis with a narrowed palpebral fissure, with multiple other starvation-mediated medical complications. Protective measures, including the use of sterile topical ophthalmic ointment and taping shut the eyelids every night, with the use of topical lubrication during the day, in addition to volume depletion and modest weight restoration, resolved both the lagophthalmos and the secondary ocular exposure symptoms. We will describe 1 case in detail and make mention of the other 4 cases.

Report of Cases. Case 1. A 26-year-old woman with anorexia nervosa was admitted to our institution with a height of 1.524 m (5 ft), a weight of 25.5 kg (56.7 lb), a BMI of 10.9, and a percentage of ideal body weight of 56%. In her first week of hospitalization, her medical complications included volume depletion, bradycardia, hypoglycemia in the single digits, hyponatremia, pancytopenia, starvation hepatitis, dysphagia causing aspiration, patulous eustachian tubes with autophonia, and refeeding hypophosphatemia. On the day of admission, she also complained of dry, irritated eyes with photophobia, and an initial examination showed pseudoptosis and enophthalmos, which were not formally measured, and 1-mm lagophthalmos. Topical lubrication was prescribed, with several drops of artificial tears in each eye hourly during the day and a ribbon of sterile ophthalmic ointment followed by direct taping of the eyelids during the night. The patient's weight reached its nadir on hospital day 5, at 23.8 kg (52.8 lb), and on hospital day 11, without any improvement in her symptoms, she was evaluated by an ophthalmologist. Examination confirmed enophthalmos bilaterally and 1-mm lagophthalmos, and corneal inspection revealed mild bilateral punctate epithelial erosions without frank defects or ulceration. Continued topical protection with nightly taping was recommended, and on hospital day 24, the patient's symptoms had resolved completely, with a weight increase from nadir of 4.5 kg (10 lb; Tables 1 and 2).

Remaining Cases. In the remaining 4 cases, each young woman with multiorgan dysfunction related to severe anorexia nervosa noted eye discomfort shortly after admission, and examination by the attending internist confirmed pseudoptosis, enophthalmos, and lagophthalmos. Patients' symptomatic responses to topical protective measures were rapid and were associated with resolution of the lagophthalmos, and thus no ophthalmology consultation was requested in these cases.

Case 2. A 27-year-old woman with anorexia nervosa was admitted to our institution with a height of 1.727 m (5 ft, 8 in) and a weight of 29.9 kg (65.8 lb), giving her a BMI of 10 and a percentage of ideal body weight of 47%. On hospital day 6, her eye symptoms developed and persisted for 10 days after topical treatment was initiated, until the patient had gained 1 kg from her nadir weight.

Case 3. A 24-year-old woman with anorexia nervosa was admitted to our institution with a height of 1.676 m (5 ft, 6 in) and a weight of 26.9 kg (59.2 lb), giving her a BMI of 9.5 and a percentage of ideal body weight of 46%. On the day of admission, she noted eye symptoms that resolved after 11 days of topical treatment. At the time of resolution, her weight had increased from its nadir by 1.3 kg.

Case 4. A 34-year-old woman with anorexia nervosa was admitted to our institution with a height of 1.524 m (5 ft), a weight of 23.8 kg (52 lb), a BMI of 10.2, and a percentage of ideal body weight of 52%. On the day of admission, she noted eye symptoms that resolved 4 days after topical treatments were instituted, at which point her weight had increased by 3.1 kg, much of which was related to improvement in volume status.

Case 5. A 21-year-old woman with anorexia nervosa was admitted to our institution with a height of 1.651 m (5 ft, 5 in), a weight of 31.2 kg (68.6 lb), a BMI of 11.4, and a percentage of ideal body weight of 55%. On hospital day 2, she described dry, irritated eyes. By hospital day 12, with a weight increase of 3.8 kg and attention to protective topical treatments, her symptoms had resolved.

| Table 1. Characteristics of 5 Patients With Severe Anorexia Nervosa |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| Characteristic               | Mean (SD)       | Mean (SD)       | Mean (SD)       | Mean (SD)       |
| Age, y                       | 26.4 (4.5)      | 27.5 (3.1)      | 63.8 (3.6)      | 10.4 (0.8)      |
| Admission weight, kg         | 251.2 (45.5)    | 51.2 (14.5)     | 24.2 (2.8)      | 3 (2-5)         |
| Height, in                   | 1.651 (0.04)    | 1.524 (0.02)    | 1.727 (0.04)    | 1.524 (0.02)    |
| BMI at admission             | 25.5 (5.6)      | 10.9 (0.5)      | 11.4 (1.2)      | 10.4 (0.5)      |
| % of ideal body weight at admission | 51.5 (4.5) | 51.2 (4.5) | 251.2 (45.5) | 51.2 (4.5) |
| Nadir weight, kg             | 26.4 (2.8)      | 27.5 (3.1)      | 63.8 (3.6)      | 10.4 (0.8)      |
| Hospital day of nadir weight | 3 (2-5)         | 3 (2-5)         | 3 (2-5)         | 3 (2-5)         |

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared). Metric unit conversion factor: To convert inches to centimeters, multiply by 2.54. Not normally distributed.

| Table 2. Course of Lagophthalmos for Patients With Severe Anorexia Nervosa |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| Course                      | Mean (SD)       | Mean (SD)       | Mean (SD)       | Mean (SD)       |
| Onset of eye symptoms, hospital day | 3 (2-7) | 11 (0-11) | 26.9 (2.6) | 26.9 (2.6) |
| Weight at diagnosis, kg     | 26.9 (2.6)      | 26.9 (2.6)      | 26.9 (2.6)      | 26.9 (2.6)      |
| Duration of symptoms, d     | 11 (0-11)       | 11 (0-11)       | 11 (0-11)       | 11 (0-11)       |
| Weight on day of symptom resolution, kg | 29.3 (3.6) | 29.3 (3.6) | 29.3 (3.6) | 29.3 (3.6) |
| Change in weight from nadir to resolution, kg | 2.1 (0.8) | 2.1 (0.8) | 2.1 (0.8) | 2.1 (0.8) |

Abbreviation: IQR, interquartile range. Not normally distributed.
Comment. To our knowledge, no description of lagophthalmos in anorexia nervosa exists in the literature. In the aforementioned case series, we present 5 patients with severe anorexia nervosa, all admitted from out of state to a highly specialized medical stabilization center, whose mean (SD) BMI of 10.4 (0.8) at admission placed them at a very high mortality risk. Given their lagophthalmos and secondary ocular exposure, each was at risk for corneal complications. The onset of ocular symptoms occurred between hospital days 1 and 4 and resolved within a median of 11 days.

Ocular surface drying is a multifactorial issue. Lagophthalmos is commonly caused by facial nerve palsy (cranial nerve VII). The differential diagnosis of such palsy includes infection, trauma, malignancy, and iatrogenic postoperative causes. Other causes of lagophthalmos are related to cicatricial changes of the eyelids due to chemical/thermal injury or disorders like Stevens-Johnson syndrome, and neurogenic lid retraction and exophthalmos as seen in thyroid-related orbit disease.

In this case series, we postulate that severe starvation, resulting in orbital fat atrophy, is the primary cause of the mechanical/anatomic abnormality between the globes and eyelids that leads to clinical lagophthalmos and ocular surface drying. Such a mechanism has also been noted in elderly patients with enophthalmos, with one case report of a patient with human immunodeficiency virus–associated lipodystrophy, whose radiologically proven orbital fat atrophy caused bilateral enophthalmos.

All but one of the patients were profoundly volume depleted on admission, and slow reversal of this state likely contributed substantially to their improvement. Indeed, the patients’ mean (SD) increase in weight from nadir to symptom resolution of 2.9 (1.8) kg reflects an increase more in their volume status than in their actual body weight. However, we have treated many volume-depleted patients with similarly low body weights who have not manifested lagophthalmos, so there may be other contributing variables. The limitations of this case series include the fact that only 1 of the 5 patients had a formal examination by an ophthalmologist and that formal measurements of enophthalmos were not performed.

In summary, these 5 patients had complications of virtually every organ system as a result of their severe anorexia nervosa, including their ocular system. However, in a relatively short amount of time, with careful protective measures, volume repletion, and initiation of nutritional rehabilitation, these patients’ ocular abnormalities and associated symptoms resolved completely. We recommend the use of preservative-free eye drops in the setting of hourly use, to reduce the incidence of preservative-mediated eye irritation. Recognition of this pathology, early intervention with strong encouragement to enter expert care, and appropriate management can prevent long-term morbidity and improve outcomes for these types of patients with severe anorexia nervosa.

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