Bilateral Crystalline Corneal Deposits as First Clinical Manifestation of Monoclonal Gammopathy: A Case Report

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Key Words
Bilateral corneal deposits · Monoclonal gammopathy · Diagnosis

Abstract
Aims: To report the clinical and diagnostic findings of a patient with bilateral corneal deposits caused by an underlying monoclonal gammopathy.

Methods: Slit-lamp biomicroscopy, confocal microscopy and additional serological tests were performed on a 35-year-old man presenting with bilateral crystalline corneal deposits.

Results: The patient was diagnosed as having monoclonal gammopathy based on elevated levels of serum immunoglobulin G. Confocal microscopy showed highly reflective (protein) deposits throughout the entire cornea, with the highest density in the epithelium and anterior stromal keratocytes.

Conclusions: Monoclonal gammopathy, a potential sign of a life-threatening disease, can lead to dense, bilateral corneal deposits. As such changes can occur long before ocular or systemic discomforts appear, an early diagnosis is crucial. Ophthalmologists should be aware of corneal deposits as potential warning signs of monoclonal gammopathy.

Introduction

A 35-year-old white man was referred to our outpatient department for further examination after a routine evaluation had demonstrated bilateral corneal opacities. According to the referring ophthalmologist, the corneal findings had remained
unchanged since the first presentation of the patient 18 months before. No systemic
disease had been previously diagnosed.

**Materials and Methods**

The evaluation and management of this patient consisted of anamnesis, visual acuity testing, slit-
lamp microscopic examination of the anterior segment and indirect funduscopic examination. Both
corneas were examined with laser scanning in vivo confocal microscopy (Heidelberg Retina Tomograph
II, Rostock Cornea Module; Heidelberg Engineering GmbH). To differentiate between the possible
diagnosis of ocular cystinosis and other systemic causes of protein deposits, additional serological tests,
including electrophoresis, were performed, followed by a bone marrow puncture.

**Results**

Anamnesis revealed mild glare sensitivity and a slightly reduced contrast sensitivity
without any systemic alterations. On examination, best corrected visual acuity was 20/25
in the patient’s right eye and 20/20 in his left eye, with an underlying myopia of –7.5 in
the right eye and –6.5 in the left eye. Slit-lamp examination revealed one pathologic
finding: bilateral, white, crystalline-like opacities throughout the entire depth of the
cornea (fig. 1). No difference in the opacities, neither between central and peripheral
tissue, nor between the right and left eye, could be seen. Laser scanning in vivo confocal
microscopy confirmed a massive amount of highly reflective crystalline deposits
throughout all corneal layers (fig. 2, fig. 3). The corneal epithelial cells and anterior
stromal keratocytes revealed the highest intracellular reflectivity of the deposits.

A hemogram verified a massive increase of immunoglobulin G (IgG) (3,775 mg/dl),
while serum protein electrophoresis demonstrated a monoclonal IgG kappa band. Based
on these results, a bone marrow puncture was performed and the analyses revealed
smoldering myeloma. Smoldering myeloma is defined by a monoclonal IgG serum
protein of >3 g/dl and/or >10% bone marrow plasma cells but with no evidence of end-
organ damage (hypercalcemia, renal insufficiency, anemia or bone lesions) [1].

**Discussion**

There is a broad variety of single case reports of corneal involvement in systemic
hyperparaproteinemia [2]. Meesmann, in 1934, was the first to report corneal deposits in
a patient with Bence-Jones proteinuria. Prospective studies concerning the incidence of
corneal involvement in monoclonal gammapathies have found only a very low incidence
[3]. Corneal involvement in monoclonal gammapathy can present in a variety of ways.
Usually, changes occur bilaterally due to a systemic cause. The precise etiology of corneal
immunoprotein deposition in the setting of paraproteinemias has been discussed in the
literature. Regarding the involved layers, all facets are possible: from deposits only
affecting the epithelial layer to deeper, stromal involvement. It is assumed that the
different locations of the abnormal immunoglobulin deposits reflect the differences in the
origin of the paraprotein. Paraprotein transport via the tear film, diffusion from aqueous
fluid from the anterior chamber and influx via the perilimbal vascular arcades are the
three mechanisms, either working alone or in combination, which comprise the most
postulated theories [4, 5]. Immunoglobulin deposits in the cornea can be exclusively intracellular, extracellular or a combination of both types [6].

Due to the rarity of this phenomenon, patients without a known systemic disease who present with diffuse corneal alterations are often misdiagnosed. Examples of differential diagnoses include lattice dystrophy, Schnyder’s crystalline dystrophy, deep filiform dystrophy and ocular cystinosis [2]. The very precise symmetrical pattern of the deposits with regard to distribution within different corneal layers (revealed by confocal microscopy; compare fig. 2 and 3) might be helpful in diagnosing a systemic disease as causative for the corneal alterations. Regarding treatment options and the prognosis of the corneal involvement, there is very little information in the literature. Many of the presented cases are associated with only minimal visual symptoms and require no specific ocular therapy. Control of the systemic condition usually improves the ocular symptoms in these patients [2]. In the very few cases of severe and lasting corneal involvement, penetrating keratoplasty seems to be the treatment of choice [7].

Disclosure Statement

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**Fig. 1.** Slit-lamp biomicroscopy reveals greyish-white deposits in the entire cornea of both eyes. a Magnification ×16. b Magnification ×25.
Fig. 2. Confocal microscopy of the cornea (right eye) shows highly reflective intracellular deposits in the epithelium (a): depth 5 μm, anterior stromal keratocytes (b): depth 52 μm and mid stromal keratocytes (c): depth 354 μm. d The endothelium appears regular in morphology and without significant intracellular deposits.
**Fig. 3.** Confocal microscopy of the cornea (left eye) shows highly reflective intracellular deposits in the epithelium (a): depth 4 μm, anterior stromal keratocytes (b): depth 49 μm and mid stromal keratocytes (c): depth 348 μm. d The endothelium appears regular in morphology and without significant intracellular deposits.
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