We report a case of corneal neovascularization in a patient with intrastromal corneal ring segments (ICRS) and demonstrate complete regression after treatment with antiinflammatory therapy. A 20-year-old man developed deep stromal neovascularization around the tip of an ICRS 4 years after implantation. Neovascularization did not affect the ICRS tunnel, and no sign of extrusion or infection was present. Topical treatment with prednisolone acetate 1.0% and cyclosporine 0.05% was started without extraction of the segment. Complete neovascular regression was achieved in 3 weeks. Intrastromal corneal ring segments can be associated with corneal neovascularization and leukomas that mimic infectious keratitis. Treatment with topical immunosuppressant drugs alone can induce neovascular regression.

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Intrastromal corneal ring segments (ICRS) are used to correct low to moderate myopia, keratoconus, and ectasia after laser in situ keratomileusis. They are made of poly(methyl methacrylate) that is biocompatible with the corneal stroma.1,2 Implanted ICRS are infrequently associated with the corneal neovascularization that can occur at or near the site of the surgical wound.1–4 We report a case in which 4 years after ICRS implantation, neovascularization occurred deep in the corneal stroma at a site other than the surgical wound.

CASE REPORT

A 20-year-old healthy man referred himself to the Centro de Ojos Quilmes, Buenos Aires, Argentina, in November 2012 with acute photophobia and decreased visual acuity in the right eye. In 2008, the eye had been treated for keratoconus ectasia by implantation of two 5.0 mm diameter Ferrara ICRS (Ferrara Ophthalmics, Ltd.) at our center. At that time, before ICRS surgery, the corrected distance visual acuity (CDVA) in the right eye was 20/800. After surgery, the uncorrected distance visual acuity (UDVA) improved to 20/800 and the CDVA improved to 20/40. During the 6-month follow-up period, there were no untoward events associated with the implanted rings.

In 2012, 2 weeks prior to visiting the center, the patient experienced the symptoms described above. He was treated unsuccessfully with topical gatifloxacin for bacterial keratitis by an ophthalmologist from another clinic. Because there was no improvement in his symptoms, he referred himself to our center. The patient's ocular history revealed contact lens use with no evidence of atopy, vernal keratoconjunctivitis, or herpes simplex virus keratitis. At the time of referral, the CDVA was 20/800 and slitlamp examination of the right eye revealed deep stromal vascularization extending to and arborizing along both ring segments, with mild underlying inflammation and deep stromal hemorrhage; the temporal ring was compromised the most (Figure 1).

Corneal topography (Tomey TMS-4, Tomey Corp.) demonstrated irregular astigmatism, predominantly at the corneal center (Figure 2). Optical coherence tomography (Optovue-RT, Optovue, Inc.) showed a stromal hyperreflective lesion that corresponded to the neovascularization site (data not shown). As the neovascularization did not affect the ICRS tunnel and no sign of extrusion was present, before explanting the segment, the patient was treated with topical drops of prednisolone acetate 1.0% 4 times daily and cyclosporine 0.05% (Cyclosporin A) 2 times daily. After 3 weeks, the deep stromal vascularization had regressed completely, leaving residual ghost vessels and a mild leukoma (Figure 3).

The topical prednisolone acetate and cyclosporine were tapered and discontinued over the next 3 months. The CDVA was restored to 20/40 CDVA, corneal topography showed surface improvement (Figure 4), and no recurrence was documented at the 3-month follow-up.
DISCUSSION

Reported postoperative complications of ICRS implantation include segment extrusion and infectious keratitis. Corneal neovascularization can occur but is an uncommon complication, generally seen in the first 3 months after surgery; it is related to poor surgical technique and shallow tunnel depth.\(^1-8\) In this particular case, the immunological response that triggered the vascularization could be attributed to various causes. The ICRS, although normally immunologically inert,\(^1,2\) can cause such responses in rare cases, even years after surgery.\(^4-6\) The reasons for the late-onset neovascularization\(^7\) and neovascularization with extrusion\(^5\) is not yet clear, although Cosar et al.\(^6\) proposed that it can be associated with the chronic use of rigid gas-permeable contact lenses.

The presence of local inflammation, diffuse leukoma, and vascularization are suggestive of infectious keratitis, especially if there is a history of it. If the patient had an infectious keratitis, the inflammation could have triggered the onset of neovascularization. Furthermore, the chronic use of contact lenses could contribute to chronic inflammation and vascularization. Chronic contact lens use can induce peripheral pannus due to corneal ischemia,\(^7-9\) so we assume our patient's use of contact lenses contributed to the inflammatory response.

Previous cases of late onset of deep corneal neovascularization were treated with segment explantation and topical immunosuppressant therapy, achieving full regression of the lesion.\(^4-6\) In our case, the segment

Figure 1. Deep neovascularization extending to and arborizing along the ICRS.

Figure 2. Corneal topography showing irregular astigmatism.

Figure 3. Complete regression of the deep stromal vascularization, leaving residual ghost vessels and a mild leukoma.
was intact and presented good depth with no sign of extrusion. As there were no signs of infection, we decided to implement topical treatment with prednisolone acetate and cyclosporine before explanting the segment. The use of cyclosporine for neovascularization was based on previous reports.10

Although rare, corneal neovascularization is a postoperative complication of ICRS implantation and should be treated. We suggest that in cases with no sign of bacterial infection and no indication of shallow tunnels with segment extrusion, topical immunosuppressant treatment is a worthy alternative before explanting the segment.

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Figure 4. Corneal topography showing increased astigmatism after treatment; however, the corneal surface became more regular, allowing improved CDVA.

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