Microbial Keratitis Following ICRS Insertion

Close physician follow-up is crucial.

BY VISHAL JHANJI, MD; AND RASIK B. VAJPAYEE, MS, FRCS(EDIN), FRANZCO

Intrastromal corneal ring segments (ICRSs) offer several advantages over other refractive techniques to treat myopia and keratoconus. There is, however, a small but definite risk that infection may occur in the early or late postoperative period. We review the diagnosis and management reported for these cases in the current literature.1-21

ICRSs are placed in the midperipheral cornea without tissue destruction or removal. These PMMA implants displace corneal lamellae to produce shortening of the central corneal arc length and flattening of the central cornea.1 Although first approved by the US Food and Drug Administration (FDA) for the treatment of mild myopia (up to 3.00 D), ICRSs were not as widely accepted for this indication as were other refractive surgery procedures such as LASIK. Now they are used primarily for the management of keratoconus with varying degree of success or to treat pellucid marginal degeneration and post-LASIK ectasia. The procedure’s associated risks include shallow segment placement, anterior chamber perforation, segment protrusion, and infection after implantation. Of these, the most serious is infection or microbial keratitis, a sight-threatening complication that has been reported in numerous case series.1-21

The overall incidence of infectious keratitis following ICRS implantation is low (Table 1);3-13 however, there have been several case reports and series of infections (Figure 1, Table 2).2,14-21 Both gram-negative and gram-positive pathogens have been reported in these cases. Time to development of infectious keratitis ranged from less than 1 week to 22 months,2 and in several cases therapeutic penetrating keratoplasty (PKP) was required for infection control.

Several factors may contribute to the development of infection after ICRS placement. Surgical technique may play a role, particularly when multiple incisions are required as with Ferrara Rings (AJL Ophthalmic, SA, Alava, Spain).2 Even with one incision, the corneal stroma may be exposed to microorganisms.4 The presence of an intrastromal foreign body carries the risk of postoperative infection because microorganisms may adhere to the ICRS at the time of implantation.

The influence of implant design on the development of infection is uncertain; PMMA has an established history of...

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>ICRS</th>
<th>Cases of infectious keratitis</th>
<th>Organisms isolated</th>
<th>Average follow-up (months)</th>
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<tbody>
<tr>
<td>Schanzlin et al3</td>
<td>449</td>
<td>Intacs</td>
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<td>Ruckhofer et al4</td>
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<td>Kwitko et al5</td>
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<td><em>S. epidermidis</em></td>
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<td>Zare et al6</td>
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<td>1</td>
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<td>Siganos et al11</td>
<td>33</td>
<td>Ferrara Ring</td>
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<td>Kymionis et al12</td>
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<td>Coskunseven et al13</td>
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<td>Keraring</td>
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favorable biocompatibility in the body. Keratocyte apoptosis and epithelial hypoplasia have been found around the channels of Intacs (Addition Technology, Inc., Des Plaines, Illinois) after their removal. A higher incidence of infection was reported in patients who had undergone Ferrara Ring implantation for keratoconus.2 The authors proposed that the triangular shape and depth of the ICRS may lead to superficial displacement, particularly in thin corneas, which would intuitively be a risk factor for late-onset infections. Multiple incisions increase the risk of wound-associated complications. Some authors also believe that a manual implantation technique may increase the risk of developing infectious complications.22 Other factors related to the development of infection include use of contact lenses, previous ocular trauma, and systemic diseases such as diabetes.2

MICROBIOLOGY OF INFECTION

Staphylococcus aureus is generally the most frequently isolated pathogen in ICRS infection, reported in up to 25% of cases, followed by Streptococcus pneumoniae, Pseudomonas, Nocardia, Klebsiella, and Paecilomices species.2 Late development of bacterial keratitis due to S epidermidis and Clostridium perfringens has been reported after Intacs implantation.15 In some cases, the ring segments can be sent to the microbiology laboratory. In a case of post-ICRS implantation infectious keratitis reported by Chalasani et al,17 the initial culture revealed S epidermidis; however, the patient's condition worsened as the size of the infiltrates increased. Hypopyon appeared within the following 24 hours. The ICRSs were removed through the original entry points 48 hours after admission and sent for culture. S epidermidis was again cultured and was found to be resistant to cefazolin and ofloxacin. Treatment was changed to hourly vancomycin 5% eye drops, and hourly tobramycin 1.3% was continued. The patient's symptoms improved, and the hypopyon resolved.

MANAGEMENT

Treatment modalities in patients with infectious keratitis require prompt, aggressive therapy with fortified topical antibiotics. ICRS removal can be avoided in some cases with the use of channel irrigation; however, removal is necessary when clinically aggressive infections are present, especially those involving the ICRS bed.14 Chaudhry reported a case of bilateral microbial keratitis caused by Streptococcus viridans 11 days after Intacs implantation. Despite aggressive medical management, infection progressed, and the ICRSs were removed from both corneas to control infectious keratitis and corneal melt.20 To remove the ICRS, the surgeon should irrigate the channels with antibiotics and obtain a repeat sample for microbiological investigations. In some cases, rapid progression and consequent severe infection may warrant early therapeutic keratoplasty. Once the infection resolves with the help of medical or surgical management, further surgery may be needed due to residual corneal scarring (Figure 2). We have developed the double-bubble deep anterior lamellar kerato-

### TABLE 2. CASE REPORTS DOCUMENTING INFECTIOUS KERATITIS FOLLOWING ICRS IMPLANTATION

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>ICRS</th>
<th>Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hofling-Lima et al2</td>
<td>8</td>
<td>Ferrara Ring and Intacs</td>
<td>*S aureus, S pneumoniae, Paecilomices, Klebsiella sp, S viridans, Nocardia sp, Pseudomonas sp, S aureus</td>
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<td>Shehadeh-Masho'our et al14</td>
<td>1</td>
<td>Intacs</td>
<td><em>S epidermidis</em></td>
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<td>Bourcier et al15</td>
<td>1</td>
<td>Intacs</td>
<td><em>C perfringens, S epidermidis</em></td>
</tr>
<tr>
<td>Galvis et al16</td>
<td>1</td>
<td>Ferrara Ring</td>
<td><em>S aureus</em></td>
</tr>
<tr>
<td>Chalasani et al17</td>
<td>1</td>
<td>Ferrara Ring</td>
<td><em>S epidermidis</em></td>
</tr>
<tr>
<td>Ibáñez-Alperte et al18</td>
<td>1</td>
<td>Intacs</td>
<td><em>S epidermidis</em></td>
</tr>
<tr>
<td>Mulet et al19</td>
<td>3</td>
<td>Ferrara Ring and Intacs</td>
<td><em>S mitis and S aureus</em></td>
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<tr>
<td>Levy and Lifshitz20</td>
<td>1</td>
<td>Intacs</td>
<td><em>Negative culture reports</em></td>
</tr>
<tr>
<td>Chaudhry et al21</td>
<td>1</td>
<td>Intacs</td>
<td><em>S viridans</em></td>
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</table>
Microbial Keratitis

By Vishal Jhanji, MD; and Rasik B. Vajpayee, MS, FRCS(Edin), FRANZCO

Microbial keratitis resulted from resistant, Staphylococcus epidermidis following ICRS implantation. The case is successfully managed with the double-bubble deep anterior lamellar keratoplasty technique.

direct link to video: http://eyetube.net/?v=micro

Vajpayee states that he has no financial interest in the products or companies mentioned. He may be reached at tel: +61 3 9929 8368; fax: +61 3 9662 3959; e-mail: rasikv@unimelb.edu.au.

Figure 2. Slit-lamp photograph showing corneal scarring after resolution of ICRS-related microbial keratitis.

plasty technique (video available at http://eyetube.net/?v=micro) for the management of residual corneal stromal scarring after the resolution of ICRS-related infection. This technique is associated with good visual outcomes and the added benefit of avoidance of rejection of the donor endothelium.

CONCLUSION

Infection following ICRS implantation is a serious complication that can occur many months after the initial procedure, necessitating close physician follow-up for an extended period. Use of femtosecond laser channel creation was proposed to be safer than the mechanical method; however, infectious keratitis has been seen even in these cases.19,20 The influence of parameters such as implant design and implantation technique on the incidence of infectious keratitis requires further evaluation.

Patient education, including a review of the signs and symptoms of possible infection and the importance of early presentation, is vital. The earliest signs and symptoms of infectious keratitis after ICRS implantation may include decreased vision, photophobia, redness, tearing, infiltrates around the ICRS, and hypopyon. Early suspicion, rapid diagnosis, use of broad-spectrum antibiotics, and removal of the ICRS in severe cases of infectious keratitis may be required to prevent sight-threatening complications.

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TAKE-HOME MESSAGE

• There is a small risk for infection after ICRS implantation.

• Infections keratitis may develop as quickly as less than 1 week or as long after surgery as 22 months.

• Surgical technique, implant design, previous ocular trauma, use of contact lenses, and systemic disease are risk factors.