Steam-like clouding observed on anterior surface of intraocular lens developed soon after implantation

Ichiro Ota, Goichiro Miyake, Tetsu Asami, Kensaku Miyake
Shohzankai Medical Foundation Miyake Eye Hospital, Nagoya, Japan

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ABSTRACT
Purpose: To report our findings in three cases of a clouding of the anterior surface of an implanted intraocular lens that developed within 14 days after implantation.

Observations: Three eyes were implanted with the same model IOL and a steam-like clouding developed on the anterior surface of the IOL. The clouding occurred on days 4, 7, and 14 after the implantation in an area of the IOL that was in contact with the aqueous humor. The clouding was accompanied by a reduction of vision in all cases but without any other abnormalities such as inflammation. The clouding was resolved by irrigation and aspiration of the anterior chamber in 2 cases at 2 and 34 days after the onset, and a spontaneous disappearance in 1 case at 14 days after the onset of the clouding. After the disappearance of the clouding, the visual acuity improved, and there were no recurrences. The solution used to irrigate the anterior chamber was collected and examined to confirm the absence of cellular materials. Elemental analyses confirmed that sodium and chloride were the predominant ions. The IOL implanted was the XACT lens (Advanced Vision Science, USA) which is a hydrophobic acrylic IOL and is characterized by having higher water content compared to other IOLs. In addition, it is packaged in 0.9% saline to maintain the pre-hydrated condition. These aspects may be related to the cause of the clouding. This IOL was implanted in 3271 eyes in our clinic, and 3 of them (0.09%) developed this clouding.

Conclusions and importance: We report our findings in 3 eyes that developed a clouding on the anterior surface of the lens soon after implantation. The clouding was localized to the area in contact with the aqueous. The cause of the clouding was not determined.

1. Introduction

The irregularities that develop on implanted intraocular lenses (IOLs) include deposits due to inflammation,4–12 calcification,4–7 discolorations,4 a glistening, a whitening, and the presence of sub-surface nano-glistening particles.9–14 Other complications related to IOL implantations are still being reported.15,16 A standard for evaluating the manufacturing process and quality of IOLs has been proposed.17 We report our findings in 3 eyes that developed a clouding of the anterior surface of the IOL. This kind of clouding has not been reported.

2. Observations

This study was approved by the Institutional Review Board of Shohzankai Medical Foundation, Miyake Eye Hospital, Nagoya, Japan, and the procedures used conformed to the tenets of the Declaration of Helsinki. A signed informed consent to perform the surgery was obtained from the 3 patients after they were given full explanations of the nature of the surgery and possible complications. They also gave approval for our use of any data collected during the surgery in future publications. Anonymity was assured.

All 3 cases were treated surgically and medically similarly. Nepafenac 0.1% (Nevanac, Alcon Laboratories, Inc. Fort Worth, US) and fluorometholone 0.1% (Flumetholon, Santen Pharmaceutical Co. LTD. Osaka, Japan) were used as anti-inflammatory drugs and were applied 3/day beginning the day before and for 5 weeks after the surgery. In addition, levofloxacin 0.5% (Santen Pharmaceutical Co. LTD. Osaka, Japan) was applied 5/day beginning two days before the surgery and 3/day after surgery for 2 weeks postoperatively.

The surgical techniques were also the same in all 3 eyes. A small incision requiring no or 1 suture was made and a continuous curvilinear capsulorrhexis and phacoemulsification were performed by one of the authors. Then a 3-piece acrylic IOL (Eternity Natural™, Santen Pharmaceutical Co. LTD. Osaka, Japan, commercial name in Japan, details are described in the Table 118).

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underwent phacoemulsification and IOL implantation in his right eye. Slight cellular infiltration was detected in the anterior chamber on the next day but the amount of flare was 14.2 which was within the normal range of inflammation. No other abnormalities were present including that of the IOL. His BCVA was 20/25. Four days after surgery, while the level of anterior chamber inflammation was within the normal range, a steam-like clouding with an accumulation of small dot-like whitish-gray material was noted on the surface of the IOL optic (Fig. 1 top, center). The BCVA had decreased to 20/32, and the patient complained of blurred vision. After 1 week, the clouding had slightly improved, and after another week the clouding had totally disappeared and BCVA improved to 20/20. The surface of the IOL findings were clear. At one year and seven months after the onset, all clinical findings were within the normal limits and without recurrence of the lens clouding.

3. Discussion

Several types of opacifications and deposits have been reported to be present on the anterior surface or within the optic of implanted postoperative IOLs.1-14 The opacifications include calcification in hydrogel1,4 and silicone IOLs,2,7 and a glistening or whitening or sub-surface nano-glistening (SSNG) in hydrophobic acrylic IOLs.9,14 These two types of abnormalities should be differentiated from the steam-like clouding reported in our three cases.

First, the time of onset was different; in cases with a silicone IOL, the deposition of calcium occurs intraoperatively with the use of Healon GV, a highly concentrated solution of high molecular-weight hyaluronate sodium, in one type of IOL.1-5 An opacification of an IOL can also occur several years postoperatively in eyes with anterior hyalosis.7 In cases with a hydrogel IOL, calcified deposits can appear several months postoperatively.3,4 In cases with a hydrophobic acrylic IOL, the glistening or SSNG does not occur shortly after surgery but begins at longer postoperative times.9-14 Our three cases developed a steam-like clouding at 4, 7, and 14 days postoperatively.

Second, the size and location of the clouding were different in our three eyes. Crystalline or calcium deposits cover the entire IOL surface including the anterior and posterior surfaces.3-7 SSNG or glistening opacities are fluid-filled microvacuoles that form within just below the surface of the optics of the IOL and not on the surface.1,7 On the other hand, our three cases developed steam-like clouding only on the anterior surface of the optic where it came into contact with the aqueous humor.

Lastly, the outcome, symptoms, treatment, and related conditions were different for the three eyes. The steam-like clouding and calcium deposits were different in several ways. First, the former occurs in cases with an implanted hydrophobic acrylic IOLs, and the latter occurs in cases with silicon and hydrogel IOLs.3-7 Second, the calcium deposits are associated with some specific condition such as the use of Healon GV1-5 or eyes having anterior hyalosis.7 In cases with calcium deposits, the reduction of vision is generally greater and may require additional surgical interventions such as IOL exchange compared to those with steam-like clouding. The differences between the three cases and those with SSNG is also clear; the symptoms in eyes with clouding appear at an early postoperative time and is acute and benign whereas that of SSNG is chronic and longstanding. A reduction of vision is present in cases with steam-like clouding but not in those with SSNG, and the former may require surgical intervention but the latter generally requires no treatment.

The mechanism(s) that cause the cloudy IOL was not definitively determined. In addition, the nature of the SSNG or glistening,14 fluid-filled microvacuoles that form within the IOL optics when the IOL in an aqueous environment was not determined. The factors that should be considered for the cloudy IOL are the IOL materials, manufacturing

| Table 1 |
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| Characteristic features of the intraocular lens material implanted.18 |

| IOL/Manufacturer | XACT/Advanced Vision Science, Goeta, CA, USA |
| --- |
| Material Composition (All With UV filters) | Copolymer of hydroxyethyl methacrylate, polyethylene glycol phenyl ethyl acrylate and styrene, crosslinked with ethylene glycol dimethylacrylate |
| Refractive Index | 1.54 |
| Water Content (%) | 4.0 |
| Contact Angle in Water (°) | 76° |
| Packaging | Prehydrated in 0.9% saline |
| Manufacturing Method | Lathe cut at room temperature |
| FDA Approved in USA | Yes |

Abbreviations: IOL, intraocular lens; UV, ultraviolet.
techniques, packaging methods, and associated ocular conditions such as blood-aqueous barrier disruption. The mechanism has not been determined but it may be related to the long-term phase separation of the water near the IOL. The mechanism for the formation of calcium deposits on the surface of hydrogel or silicone IOLs has also not been fully determined. An excessive level of calcium or phosphate from the intraocular solutions or osmotic gradient created by the viscoelastic material that increases the calcium concentration usually with the use of BSS Plus has been suggested as a possible cause of the clouding. Inflammation can be eliminated as the cause of the clouding because the 3 eyes did not show any signs of inflammation, and inflammatory cells were not present in the collected irrigation fluid. The early post-operative nature of the clouding suggests that the packaging in 0.9% saline to maintain pre-hydrated condition may be a possible mechanism. The fact that the deposits on the anterior surface of the optic were localized to the area which came in contact with the intraocular irrigating solution or the aqueous humor may be related to the origin of this kind of clouding. The interaction of this particular hydrophobic IOL surface and chemical composition of the irrigating solution, viscoelastic material, and the aqueous humor may play a role. Among the previously reported deposits, calcium deposits have some common features but we were unable to detect significant amount of calcium by elemental analysis of the irrigation fluid from our eyes.

4. Summary

We described the findings in 3 cases with clouding of the anterior surface of the optic of an implanted IOL. Similar alterations have also not been reported by the manufacturer during the testing phase of the
IOL. The onset was 4, 7, and 14 days after the implantation. The deposits disappeared spontaneously in 1 case at 14 days after the onset, and 2 cases required irrigation with an irrigation and aspiration tip at 2 and 34 days after the onset. During the onset, no inflammatory signs were detected except for a decrease in the visual acuity, which recovered after the clouding was cleared. Although no specific cause was found, the water content of this IOL is slightly higher and is packaged in 0.9% saline to maintain pre-hydrated condition.18 These features may be related to the cause of the surface deposits.

Patient consent

The patients consented to publication of the case in writing and orally.

Disclosures

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Conflicts of interest

The authors declare that there is no conflict of interests regarding this paper.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

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