Case Reports in Ophthalmology

Case Rep Ophthalmol 2023;14:484–490

DOI: 10.1159/000533768
Received: March 7, 2023
Accepted: August 20, 2023
Published online: September 26, 2023

Case Report

Sterile Corneal Infiltrates following Cataract Surgery: Case Series

Antonella Franch[a] Silvia Bini[b] Lorena Francescutti[a] Federica Birattari[a] Pia Leon[a] Daniele Bonamartini[a] Tommaso Gambato[a] Romeo Altafini[b]

[a]Ophthalmology Unit, Ospedale SS Giovanni e Paolo, ULSS 3 Serenissima, Venice, Italy;
[b]Ophthalmology Unit, Presidio ospedaliero di Dolo, ULSS 3 Serenissima, Venice, Italy

Keywords

Corneal infiltrates · Sterile corneal infiltrate · Cataract surgery · Cataract surgery complication · Corneal incision

Abstract

We report a case series of 26 eyes of 26 patients undergoing planned cataract surgery from December 2021 to March 2022, who were diagnosed as having whitish round infiltrates in the surgical corneal incisions. The infiltrates were detected at the first check after 5–8 days from cataract surgery and were located either within the main corneal incision and/or in the smaller incisions. Corneal infiltrates (CIs) were single or multiple, without epithelial defects, and painless. All infiltrates were initially treated with full topical antibiotic coverage, in order to control eventual and serious postsurgical infection. However, at daily checks, the clinical course of CIs suggested a sterile etiology. For this reason, steroidal topical treatment was maintained for a long time with slow tapering until complete remission of the CIs. All infiltrates resolved completely in around 30–40 days. The surgical instruments and the sterilization process were scrutinized. A white amorphous material was found mainly on non-disposable anterior chamber cannulas and on irrigation/aspiration tips. Disposable cannulas were adopted, and machinery for cleaning and sterilization procedures were reviewed, with specific reference to water softener renewal. Thanks to these precautions, CIs never occurred again. Finally, our hypothesis was an immune corneal reaction to amorphous deposit on cannula tips. This case series describes a previously unknown complication of cataract surgery and our experience might be useful for other surgeons.

Correspondence to:
Silvia Bini, silvia.bini@aulss3.veneto.it

Case Rep Ophthalmol 2023;14:484–490
DOI: 10.1159/000533768

Introduction

Cataract surgery has evolved dramatically over the last 2 decades; however, surgeons should always be prepared to manage any possible complication. Common corneal complications of cataract surgery include errors in dimension and orientation of corneal incision, corneal edema due to elevated ultrasound use, and tears of Descemet's membrane [1–4]. Corneal infiltrates (CIs) are not described as a complication of cataract surgery itself [1–4]. Generally, when facing CIs, it is necessary to determine whether the etiology is sterile or infectious [5, 6]. This differentiation is crucial to start adequate treatment, that is completely different depending upon etiology. However, a definite diagnosis is not always possible at first examination. It is generally assumed that in corneal infections with an intact epithelium, the infiltrates are sterile in nature, while with an infectious etiology, an epithelial defect is usually present. Even though this is mostly true, some bacteria or fungi may lie under an intact epithelium. Infectious infiltrates are typically larger in size than sterile (>1 mm), and more centrally located [5, 6]. Mucopurulent discharge, pain, and photophobia are associated with infectious rather than sterile infiltrates, as well as anterior chamber reaction and hypopyon, which are more prominent in infective forms [5, 6]. However, net distinction solely based on these parameters may lead to misdiagnosis and when unclear, a full antibiotic coverage is mandatory as first-line treatment. Frequent checks are recommended to monitor clinical evolution and response to treatment.

In our case series, we describe patients affected by CIs diagnosed after cataract surgery (time interval: 5–8 days). CIs were detected in several patients, despite uncomplicated surgical procedures. The etiology and management are described hereafter.

Case Presentation

Patients' Description

Twenty-six eyes of 26 patients who underwent planned cataract surgery were included in this case series. All patients were diagnosed as having whitish round CIs in the corneal incisions after surgery (shown in Fig. 1). A written informed consent was obtained from all patients to allow for publication of medical cases and any accompanying images. Ethic Committee's approval was not necessary, since only routine procedures were applied. The patients were operated on at Venice and Dolo hospitals, representing two of the four hospital ophthalmic units belonging to the local health authority, ULSS3 Serenissima, in the Veneto region. Specifically, ULSS3 Serenissima is the local socio-sanitary unit, composed of a group of hospitals which are distributed in a common geographic area, and cooperate in order to provide complete health assistance to all the population living in that geographical area. Dolo Hospital is also hosting the "cataract project," a collective project in which all surgeons of ULSS3 Serenissima work in turn in a common operating theater, cooperate, and share their own surgical and clinical experience. Patients included in this study were operated on mainly at Venice Hospital (n = 24) and a minority in Dolo Hospital (n = 2). All patients included in our study underwent standard cataract surgery between December 2021 and March 2022. This time interval reflects the beginning and end of CI detection. From day 1 to day 31 of December 2021, a total of 4 cases, specifically 1 case out of 60 operated eyes per week were affected by CIs (1 case per 60 eyes per week, incidence 1.67% per week). In January 2022, the incidence per week increased rapidly. Globally, from December 2021 to March 2022, around 3.6% of all operated eyes (26/720) were diagnosed as having CIs. Mean age of patients was 75.52 ± 5.85 (range: 60–83 years), 70% were female and 30% were male. Patients were visited at 1 day (day 1) and 1 week (interval: 5–8 days) after cataract surgery. At day 1, none of the operated

Case Rep Ophthalmol 2023;14:484–490
DOI: 10.1159/000533768

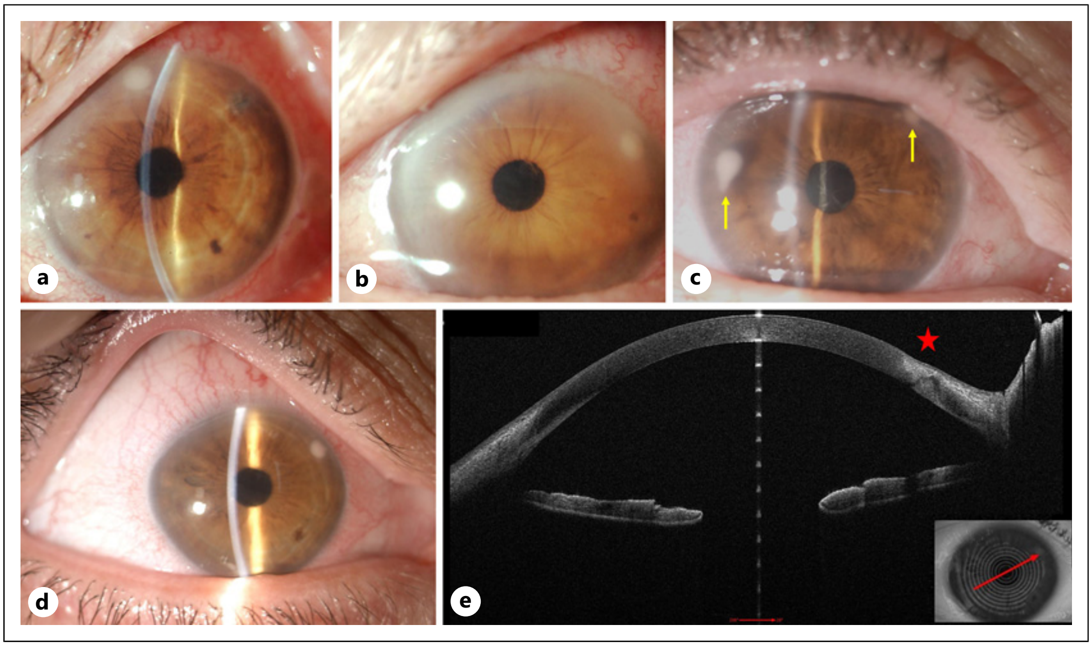

Fig. 1. Anterior segment photographs (**a–d**) and an anterior segment OCT image (**d**) of different patients affected by whitish CIs in the corneal incisions after cataract surgery. **c** The yellow arrows indicate a case of multiple infiltrates in the same eye. **e** The red star indicates the superficial location of the infiltrate seen as area of hyper-reflectivity in correspondence of the white infiltrate (see also the red arrow on topography map for exact localization). In all cases, note that the central cornea is clear.

eyes were affected by CIs, while 100% CIs were observed at 1 week check. This observation suggested a delayed development of infiltrates. The CIs were single or multiple (more than one per eye) and specifically located in the corneal surgical incisions: either in the main and/or in the lateral corneal cuts, both in coaxial irrigation/aspiration (I/A) procedure, and in bimanual I/A technique. All infiltrates shared common characteristics: no fluorescein staining, absent or mild epithelial defect, asymptomatic, no anterior chamber reaction, no eyelid involvement, no corneal edema. Variable IOLs were implanted in these patients, and regardless of the IOL manufacturer, we detected infiltrates. The IOLs were AcrySof IOL, Model SN60WF, Alcon; Tecnis Eyhance IOL, Model DIB00, Johnson & Johnson; Nanex multiSert IOL, Model NC1-SP, Hoya.

Clinical Management of CIs

Despite several characteristics suggesting the sterile nature of postsurgical CIs, we managed them as infectious in nature for caution in newly operated eyes and with the suspicion of postoperative infection or atypical onset of toxic anterior segment syndrome (TASS) [7]. In view of the general definition of TASS as "characterized by sterile postoperative inflammation of anterior segment after intraocular surgery" and its wide range of severity at presentation, we also considered TASS in differential diagnoses at the beginning. We hypothesized that the infiltrates could represent an atypical presentation of TASS, with onset on corneal tissue instead of in the anterior chamber. We decided to perform the scraping of some infiltrates and undertook cytological examination. We only found nonspecific inflammatory cells but no bacteria or fungi. An OCT of anterior segment was also performed in some patients, showing the infiltrate's depth in the upper third section of the corneal stroma.

All affected eyes were treated with a reinforcement of topical antibiotics, by adding moxifloxacin 5 mg/mL, four times a day to standard postoperative protocol (see protocol's detail below). Daily follow-up was started. After 7 days of full antibiotic therapy with unmodified aspect of the infiltrates, topical steroid (dexamethasone eye drops) was maintained 4 times a day for 7 days and slowly tapered according to clinical response and moxifloxacin was suspended. After 30–50 days, all infiltrates had resolved in 100% of operated eyes, reinforcing the hypothesis of the sterile nature.

Precautionary Measures

As previously mentioned, the incidence of CIs increased from December 2021 to January 2022. For this reason, in January, surgical activity was stopped for 24 h in order to adopt precautionary measures. A full cleaning of the operating theater was performed, as well as examination of surgical material. Custom packs, viscoelastic supplies, and all surgical instruments were rigorously checked. At the same time, all ophthalmic surgeons at ULSS3 were informed and asked to report any further cases of CIs in the operated eyes.

The sterility of CIs and their location suggested starting a scrupulous inspection of surgical instruments passing through the corneal incisions: anterior chamber cannulas and I/A cannulas. Macroscopically, an amorphous white material was detected mainly on anterior chamber cannulas (shown in Fig. 2) and, to a lesser extent, on I/A tips. This material was considered as potentially responsible for the onset of CIs in corneal cuts, either main corneal incisions or minor lateral cuts. Therefore, some samples of white deposits were collected and analyzed by microscope (shown in Fig. 3). The nature of this material was not completely clarified by microscopic analysis; however, the main hypothesis was a calcareous nature. After detection of amorphous deposits, the anterior camber cannulas were replaced by disposable ones. All cleaning procedures and sterilizing machines underwent meticulous check and maintenance. Usually, disinfection of cannulas for anterior chamber and I/A was obtained by two steps: first, hand wash with tap water and solution of surfactants for surgical instruments, and then cleaning by washer disinfector (Steelco, Type DS610/1 D). The washer disinfector and water softener (which removes calcium from water) underwent maintenance. In March 2022, no further cases of sterile postsurgical CIs were detected.

Postoperative Topical Treatment Protocol in Cataract Surgery

- Tobramycin 0.3% eye drops 3 times a day for 7 days (total: 1 week);
- Bromfenac 0.9 mg/mL eye drops twice a day for 14 days (total: 2 weeks);
- Dexamethasone eye drops 4 times a day for 7 days, three times a day for 7 days, and twice a day for 3 days (total: 3 weeks).

Discussion

CIs are not described as a complication of cataract surgery. However, in our case series, we present several patients having white CIs in the early postoperative time after cataract surgery located inside corneal incisions. Despite typical signs of sterile nature, at first our therapeutic approach was as for a corneal infection or atypical presentation of TASS [7]. However, TASS usually has a more dramatic clinical course. TASS is in fact, an acute, severe intraocular inflammation accompanied by diffuse corneal edema within 1–2 days after cataract surgery. The possible cause is eye reaction to external agents, such as bacterial endotoxins or particulate contamination of balanced salt solutions, abnormal PH of intraocular irrigating solutions, denatured ophthalmic viscosurgical devices, intraocular

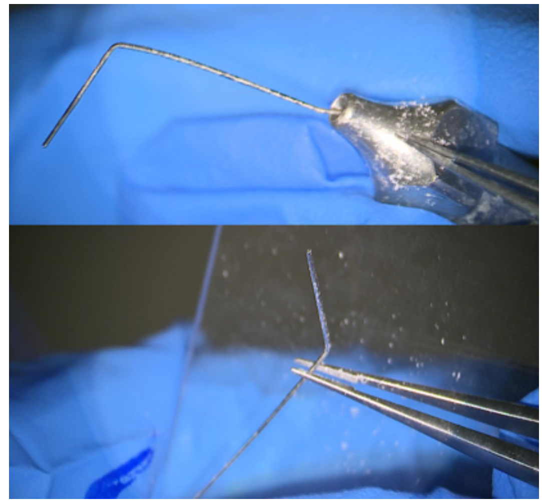

Fig. 2. Macroscopic observation of amorphous white material on anterior chamber cannulas.

medications such as intracameral antibiotics, and finally, inadequate sterilization of surgical instruments and tubing, preservatives, or metallic precipitates, etc. [7, 8].

Since infection is a serious complication in operated eyes, antibiotic coverage was promptly reinforced as described. Clinical course and no resolution of CIs despite antibiotic treatment, confirmed the hypothesis of sterile nature of CIs, therefore steroidal treatment was safely prolonged. Meanwhile, we reviewed all possible causes of CIs in corneal incision, with specific attention paid to the correct use and cleaning of surgical instruments. Since amorphous deposits (probably but not certainly calcium carbonates) were found on anterior segment cannulas and I/A cannulas, the washer disinfector and water softener (device removing calcium from tap water) underwent stringent maintenance. A possible malfunction in the water softener was suspected.

To overcome the onset of further CIs in subsequent surgical procedures, disposable anterior chamber cannulas were adopted and all surgical and disinfection practices were revised. The water softener issue was resolved. After these precautions were applied, no more CIs were detected in postsurgical checks by the end of March 2022.

Our final hypothesis was that amorphous deposits on the tips of cannulas were able to induce an immune reaction in the corneal incisions. Briefly, the response in injured corneal stroma activates a complex cascade as a response to injury, such as a foreign body. Activated keratocytes become able to produce high amounts of pro-inflammatory factors (chemokines) and trigger an influx of inflammatory cells leading to stromal opacification. After activation and local inflammation, normal form and function of the stroma is slowly restored. Stromal healing cascade usually restores stromal transparency [9–12].

To our knowledge, this is the first report in the literature describing CIs in corneal incisions after cataract surgery. Topical steroidal treatment was successful in the resolution of these infiltrates. Even though we cannot conclude certainly that the resolution is secondary solely to the washer disinfector or the use of disposable components, we may state that probably, the non-disposable cannulas washed by the nonoptimally functioning washer disinfector were responsible for the CIs. Therefore, the use of disposable cannulas and the revision of cleaning and sterilization procedures prevented new cases. We advise all surgeons in the case of detection of postsurgical CIs to consider reviewing all cleaning steps of surgical instruments and correct function of machinery in use for sterilization. Moreover, we encourage the use of disposable devices, at least temporarily, when facing complications like ours, in the effort to avoid further infiltrates in newly operated eyes [13]. After initial management of infiltrates, long-term precautions or changes in the operating theater may be

Case Rep Ophthalmol 2023;14:484–490
DOI: 10.1159/000533768

Fig. 3. Hematoxylin and eosin staining showing an eosinophilic amorphous material (magnification ×4, ×10) under light microscopy.

reasonably planned. These measures will help prevent complications such as CIs described in our case series. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000533768).

Statement of Ethics

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Ethical approval was not required since it is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from all the patients for the publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

All authors declare no conflicts of interest and no financial or nonfinancial involvement.

Funding Sources

No funding was necessary for this manuscript.

Author Contributions

Antonella Franch and Romeo Altafini conceived the manuscript; Silvia Bini drafted the manuscript; and Lorena Francescutti, Federica Birattari, Pia Leon, Daniele Bonamartini, and Tommaso Gambato collected patients' data and provided images. All authors approved the final version of the manuscript.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material. Further inquiries can be directed to the corresponding author.

References

1 Zhang JH, Ramke J, Lee CN, Gordon I, Safi S, Lingham G, et al. A systematic review of clinical practice guidelines for cataract: evidence to support the development of the WHO package of eye care interventions. Vision. 2022;6(2):36.
2 Nordlund ML, Marques DM, Marques FF, Cionni RJ, Osher RH. Techniques for managing common complications of cataract surgery. Curr Opin Ophthalmol. 2003 Feb;14(1):7–19.
3 Gogate PM. Small incision cataract surgery: complications and mini-review. Indian J Ophthalmol. 2009 Jan-Feb;57(1):45–9.
4 Sharma N, Singhal D, Nair SP, Sahay P, Sreeshankar SS, Maharana PK. Corneal edema after phacoemulsification. Indian J Ophthalmol. 2017 Dec;65(12):1381–9.
5 Stein RM, Clinch TE, Cohen EJ, Genvert GI, Arentsen JJ, Laibson PR. Infected vs sterile corneal infiltrates in contact lens wearers. Am J Ophthalmol. 1988 Jun 15;105(6):632–6.
6 Mereaux D, Knoeri J, Jouve L, Laroche L, Borderie V, Bouheraoua N. Sterile keratitis following standard corneal collagen crosslinking: a case series and literature review. J Fr Ophtalmol. 2019 Jun;42(6):603–11.
7 Park CY, Lee JK, Chuck RS. Toxic anterior segment syndrome-an updated review. BMC Ophthalmol. 2018 Oct 25;18(1):276.
8 Bodnar Z, Clouser S, Mamalis N. Toxic anterior segment syndrome: update on the most common causes. J Cataract Refract Surg. 2012;38(11):1902–10.
9 Sharma N, Kaur M, Agarwal T, Sangwan VS, Vajpayee RB. Treatment of acute ocular chemical burns. Surv Ophthalmol. 2018 Mar-Apr;63(2):214–35.
10 Schrage NF, Abu SS, Hermanns L, Panfil C, Dutescu RM, Burns. Irrigation with phosphate-buffered saline causes corneal calcification during treatment of ocular burns. Burns. 2019 Dec;45(8):1871–9.
11 Fortingo N, Melnyk S, Sutton SH, Watsky MA, Bollag WB. Innate immune system activation, inflammation and corneal wound healing. Int J Mol Sci. 2022 Nov 29;23(23):14933.
12 Kamil S, Mohan RR. Corneal stromal wound healing: major regulators and therapeutic targets. Ocul Surf. 2021 Jan;19:290–306.
13 Thiel CL, Schehlein E, Ravilla T, Ravindran RD, Robin AL, Saeedi OJ, et al. Cataract surgery and environmental sustainability: waste and lifecycle assessment of phacoemulsification at a private healthcare facility. J Cataract Refract Surg. 2017 Nov;43(11):1391–8.