CASE REPORT

Siderotic cataract after intraocular foreign body removal

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A 39-year-old man developed ocular siderosis months after an intraocular foreign body (IOFB) entered the eye during trauma from hammering metal. He presented to the emergency department with progressive blurry vision in the right eye 4 months after initial trauma, and examination disclosed an IOFB in the vitreous. Electroretinogram demonstrated an increased a-wave and decreased b-wave, consistent with ocular siderosis. He underwent vitrectomy and IOFB removal, with resolution of symptoms. Five months later, the patient developed a siderotic cataract in the same eye, and slitlamp examination showed rust-colored metal deposits on the anterior capsule and posterior subcapsular cataract of the right eye. The patient underwent a successful cataract surgery, and his vision returned to baseline. This case highlights an uncommon complication of IOFBs, the variable timeline and manifestations of siderosis, and the possibility of an underlying chemical process determining the visual pattern of the siderotic cataract.

Ocular siderosis, also known as siderosis bulbi, was first described in 1894 by von Hippel. It can develop due to an iron-containing intraocular foreign body (IOFB), causing a degenerative process induced by chemical reactions between iron particles and ocular tissues. The ferrous particles dissociate from the IOFB and can deposit in the intraocular epithelial structures, such as the lens epithelium, iris, ciliary body epithelium, and the sensory retina, where it can exert toxic effects on cellular enzyme systems.

Ocular siderosis may present with a yellow cataract with brown deposits on the anterior capsule, pigmentary retinal degeneration, and optic disc hyperemia, leading to attenuated vessels and visual field loss. The resulting retinopathy can be confirmed by characteristic electroretinogram (ERG) changes. Initially, the a-wave increases, and a progressive reduction in the b-wave subsequently follows.

Here, we describe a unique presentation of a siderotic cataract and ocular siderosis in a patient who underwent vitrectomy and IOFB removal 4 months after the initial eye trauma.

CASE REPORT

A 39-year-old male mechanic presented to the emergency department 4 months after trauma to the right eye while hammering metal. He complained of difficulty focusing and light flashes in the right eye since the injury. On initial examination, the visual acuity was 20/20, and slitlamp examination revealed traumatic mydriasis, iritis, and pigment on the conjunctiva 3.0 mm posterior to the limbus at 5 o’clock, indicating an entry wound. A metallic IOFB was found floating in the vitreous humor at 6 o’clock (Figure 1). ERG demonstrated an increased a-wave and decreased b-wave, consistent with siderosis (Figure 2).

The patient underwent vitrectomy and IOFB removal without complications the following week. The IOFB was removed from the inferior vitreous, and laser was applied to the areas of pigmentation at the entry sign in the inferior pars plana. Finally, a fluid–air exchange was performed.

Five months later, the patient presented to the clinic with a reduced visual acuity of 20/30, black floaters, and visible deposits in the right eye in a clock face pattern (Figure 3). Slitlamp examination demonstrated metal deposits on the anterior capsule in a symmetric, circular configuration and a posterior subcapsular cataract, as seen in Figure 2. Ganglion cell optical coherence tomography showed retinal thinning and atrophy with a normal foveal contour (Figure 4), and the retina was attached.

The patient underwent uneventful cataract surgery of the right eye (Video 1, available at 1_m9sy8mk4). On pathology, the Perls’ Prussian blue stain was positive within the lens epithelium, demonstrating iron deposition and siderosis (Figure 5). At the most recent follow-up visit 1 year after the initial diagnosis of ocular siderosis, corrected distance visual acuity was 20/20.

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Here, we describe a unique presentation of a siderotic cataract and ocular siderosis in a patient who underwent vitrectomy and IOFB removal 4 months after the initial eye trauma.
DISCUSSION
Ocular siderosis is a chemical manifestation caused by an IOFB that contains iron. Iron reacts with carbon dioxide to form ferrous carbonate, which diffuses into surrounding tissues. Iron converts to iron oxide and causes lysosomal breakdown and enzyme disruption. In addition, iron oxide fuses with proteins and deposits as yellow-brown particles.\(^3\)\(^4\) The iron deposition may lead to iris heterochromia, pupillary mydriasis, cataract formation, secondary glaucoma, and retinal pigmentary degeneration.\(^3\)\(^5\)\(^6\) Our patient presented with rust-colored iron deposits on the anterior capsule. Although ocular siderosis is a known but unique complication of IOFBs, interestingly, the pattern of deposition was a near symmetric clock face distribution, which to our knowledge has not been reported in the literature (Figure 3). The features of the IOFB that lead to a certain cataract pattern are unknown, but it may represent an underlying chemical and pathological process.

In addition to the pigmentation that can be visualized, ERG changes can be characteristic of ocular siderosis. Specifically, an increased a-wave followed by a progressive decline of the b-wave is usually seen.\(^7\) The toxic effects of iron on the retina cause dysfunction in all retinal layers, with a greater effect on the inner retina than on the outer retina in later stages.\(^8\) The ERG changes indicate that rods are more sensitive to the toxic chemical sequelae than the cones. Over time, the responses of the rod cells diminish in amplitude.\(^9\) Our patient’s ERG displayed the common changes that occur with ocular siderosis.

Patients presenting with siderosis normally present with a history of ocular trauma yet may remain asymptomatic until later when visual acuity decreases.\(^10\)\(^11\) In addition, the timing of the development of siderotic cataract is variable: from as early as a few days to several years after the injury, and before or after IOFB removal.\(^3\) In one case series of nine patients who sustained an IOFB, siderotic cataracts developed between 3 months and 12 years (mean: 2.9 years) after the initial trauma and IOFB removal.\(^9\) Another patient with a missed IOFB developed siderotic changes 1 year after trauma.\(^12\) Lens siderosis was proven histopathologically in another patient with a history of trauma, but there were no signs of a retained IOFB.\(^13\) Our patient presented with iron deposits 5 months after IOFB removal. Taken together, our case along with previous cases suggests that the timing of clinical manifestations of ocular siderosis is unpredictable, and that it may occur even if the IOFB is removed. Despite this uncertainty, if the IOFB is removed in a timely manner, the visual acuity may improve, and the visible siderotic and ERG signal changes are reversible.\(^14\)\(^16\) Finally, the symmetrical pattern of the cataract appearance may highlight the possibility of an underlying chemical process that influences the pattern of siderotic deposition.

This case illustrates a unique complication that can arise due to an iron-containing IOFB. It highlights the clinical manifestations that arise with ocular siderosis and also demonstrates the importance of close monitoring of all...
patients with a history of ocular trauma with and without an IOFB. The timeline of siderotic changes is variable, as is the visual appearance of the cataract, which may be due to an unknown underlying process. Even if the IOFB is removed in a timely manner, a siderotic cataract and damage to the retina may develop. With careful follow-up, the changes due to ocular siderosis may be prevented or reversed.

WHAT WAS KNOWN
• Ocular siderosis may develop from intraocular foreign objects through a degenerative chemical process between iron particles and ocular tissue.
• The timing of a siderotic cataract and the pattern of deposition is variable.

WHAT THIS PAPER ADDS
• The visual appearance of the siderotic cataract in our case was a near symmetric, circular configuration. Therefore, we hypothesize a siderotic cataract may be due to an underlying chemical process.

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Figure 4. Retinal thinning is seen in the right eye.

Figure 5. Lens capsule and lens epithelium: Iron deposition is present within the lens epithelium (Perls’ Prussian blue; original magnification ×200)
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