Case Report

Spectral domain optical coherence tomography and en-face imaging in presumed ocular chalcosis

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Abstract

A 35-year-old male, with a history of injury sustained three years back, underwent pars plana vitrectomy with intravitreal copper foreign body removal. Post-operatively, visual acuity improved; however, glistening refractile particles were seen at the macula. Spectral domain optical coherence tomography and en-face imaging were performed to localise the level of the deposits. To the best of our knowledge, this is the first such documentation in presumed ocular chalcosis.

Keywords: Ocular chalcosis, Intravitreal foreign body, Spectral domain optical coherence tomography, En-face imaging

Introduction

Intraocular foreign bodies composed of copper are commonly encountered following penetrating eye injuries. The clinical presentation is dependent on the copper content. While objects containing more than 85% copper can result in endophthalmitis and severe visual loss, diluted alloys are less toxic and cause a milder reaction. This difference may be the result of diminution of available cuprous ions from diluted alloys of copper.

Case report

A 35-year-old male presented with progressively decreasing vision in his right eye following cataract surgery with intraocular (IOL) implantation that had been performed elsewhere three years back. There was history of trauma with a copper wire prior to this as he worked in a factory that manufactured sewing machines. No records of the previous surgery were available.

His best corrected visual acuity was 6/60 in the right eye and 6/6 in the left eye. Slit lamp examination demonstrated a pin point inferior paracentral corneal scar, unremarkable Descemet’s membrane, flare in the anterior chamber and a posterior chamber IOL in the bag in the right eye. The pupillary reactions were normal and there was no heterochromia. Gonioscopy revealed no abnormality and the intraocular pressure was 16 mmHg by applanation tonometry. Dilated examination showed vitreous opacities that were dense enough to preclude a view of the retina. The left eye examination was unremarkable. An ultrasound B-scan of the right eye disclosed the presence of an intravitreal metallic foreign body (Fig. 1). Electoretinography documented comparable values between the two eyes.

The patient underwent 23 gauge pars plana vitrectomy with removal of the wire from the vitreous cavity after enlarging the superonasal port to 20 gauge. Intraoperatively, fibrillary degeneration of the vitreous with interspersed brownish particles was observed and the foreign body was found to be encapsulated, lying in the inferior vitreous. The coated copper wire was 7 mm in length and 0.4 mm in thickness.
Spectroscopic analysis confirmed that the copper content was 60%. At 3 weeks post-operatively, BCVA improved to 6/12. Fundus examination showed the presence of refractile deposits at the macula (Fig. 2A). Spectral domain optical coherence tomography (SD-OCT) performed using RTVue SD-OCT (Optovue Inc, Fremont, California, USA) documented hyperreflectivity in the anterior most layer of the retina. The underlying layers were unremarkable. (Fig. 2B). En-face imaging demonstrated that the hyperreflectivity was limited to the internal limiting membrane (ILM) (Fig. 2C).

Discussion

Histopathological studies have demonstrated that copper deposition in the eye may occur in a generalised pattern, that is frequent with foreign bodies containing more than 85% copper, or a localised pattern in areas adjacent to the foreign body seen in those with less than 85% copper. While the copper concentration of the aqueous humour was elevated and the copper foreign body was tarnished in the former pattern, the levels were normal and the foreign body was encapsulated or shiny in the latter. Spectroscopic evaluation of the foreign body in our case confirmed that it belonged to the latter category. Fibrous encapsulation, seen more with chronic cases in which the foreign body has been present in the eye for one or more years, appears to prevent widespread dissemination of copper thus reducing toxicity to the retina and other ocular structures. This is in contrast to the observations of Duke-Elder, who described that widespread copper deposition producing the clinical picture of chalcosis is seen with foreign bodies with copper content less than 85%.  

Fig. 1. Pre-operative ultrasound B scan of the right eye showing an intravitreal metallic foreign body. There was history of trauma with a copper wire three years back.
Copper has an affinity for deposition along basement membranes. In the eye, it accumulates in the Descemet membrane, clinically corresponding to the Kayser-Fleischer ring and in the ILM of the retina. The lack of intracellular deposits of toxic particles may account for the more benign course in chalcosis, as compared to siderosis. Reversible maculopathy in presumed ocular chalcosis has been described earlier; however, OCT was not performed. This is the first report of SD-OCT and en-face imaging in a case of presumed ocular chalcosis. The hyperreflectivity seen in the layer corresponding to the ILM might be the copper deposition, as seen on the clinical photograph. It is unclear as to why the ILM at the macula is the preferred site for deposition, and it has been suggested that it may be related to the higher metabolic rate of this area as well as fluid movements in the eye. Preservation of the retinal architecture, including the photoreceptor layer, might explain the good visual recovery in this case.

Copper foreign bodies present near the retina or choroid are more likely to induce massive cellular infiltration while those in the mid-vitreous can lie uneventfully for long periods. This has been attributed to higher oxygen levels in the region of the retina and choroid. The current case with an intravitreal foreign body did not exhibit signs of retinal toxicity as evidenced preoperatively by electroretinography and postoperatively by adequate visual recovery.

To conclude, this case of an intravitreal foreign body, that was the fragment of a coated copper wire, illustrates that a satisfactory visual outcome can be obtained after foreign body removal even after 3 years following injury. Decreased vision due to vitreous opacification was the presenting feature in this case, that was rectified by vitrectomy. Macular changes reflecting copper deposition in the ILM, along with SD-OCT features were documented. These changes did not preclude a good visual recovery. Nevertheless, it cannot be overemphasized that all patients with a history or sign suggestive of penetrating ocular injury must undergo a detailed evaluation too rule out the presence of an intraocular foreign body. Also, measures must be taken to ensure that workers dealing with metals such as iron and copper use protective eyewear.

Conflict of interest

The authors declared that there is no conflict of interest.

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Fig. 2. (A) Fundus photograph of the right eye at 3 weeks following intravitreal copper coated wire removal, showing glistening, refractile particles at the macula. (B) Spectral domain optical coherence tomography scan demonstrates hyperreflectivity in the anterior most retinal layer. The remaining retinal layers are unremarkable. (C) En-face imaging confirmed that the hyperreflectivity was limited to the internal limiting membrane (ILM).