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Irreversible Damage to the Fovea in Indocyanine Green-assisted Internal Limiting Membrane Peeling

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Purpose: To report a case of irreversible damage to the fovea following indocyanine green (ICG)-assisted internal limiting membrane (ILM) peeling.

Case summary: A 77-year-old man with an epiretinal membrane on his right eye received pars plana vitrectomy followed by ILM peeling. After ILM peeling, ICG dye was applied to identify any remnant ILM tissue. Immediately after, the ILM-peeled macular area exhibited a green color with an oval shape and the pigmentation persisted despite several attempts to wash the area with a balanced salt solution. Fundus photography and spectral domain optical coherence tomography revealed obvious macular coloration and outer retinal disruption, respectively. Visual acuity, which was 20/100 preoperatively, dropped to around 20/500 postoperatively, failing to show remarkable improvement over a follow-up period of 4 years.

Conclusions: The application of ICG on the bare retina caused irreversible damage. ICG dye should be used with caution.

Keywords: Indocyanine green; Internal limiting membrane peeling; Vitrectomy

Introduction

Indocyanine green (ICG) dye facilitates easier identification of the internal limiting membrane (ILM) with its selective staining property [1]. However, its retinotoxicity [2,3] has limited the use of ICG in vitreoretinal surgery. Here, we describe a case in which instantaneous coloration of the fovea resulted in irreversible damage of the retina in the absence of ILM.

Case Report

A 77-year-old man complained of decreased visual acuity in his right eye that persisted for more than 5 years. He had hypertension but no history of intraocular surgery. The best-corrected visual acuity in the right eye was 20/100. His right eye had both a cataract and epiretinal membrane (ERM) (Fig. 1A), and posterior vitreous detachment was observed.

Phacoemulsification with intraocular lens implantation was performed under local anesthesia, followed by 23 G

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Figure 1. Preoperative spectral-domain optical coherence tomography (SD-OCT), postoperative fundus photograph, and SD-OCT at postoperative 1 week. (A) Preoperative SD-OCT showed an epiretinal membrane. (B) Fundus photographs showed a green-stained, clearly-demarcated macular area devoid of ILM. (C) SD-OCT images showed damage on the outer retinal layer, including disruption at the IS/OS junction and RPE atrophy. ILM = internal limiting membrane; IS/OS = inner/outer segment of the photoreceptor; RPE = retinal pigment epithelium.

pars plana vitrectomy. After removing the vitreous, circular, three-disc diameter-sized areas of both the ERM and the ILM were removed. We used a 0.25% solution for the ICG dye. The solution was made by injecting 10.0 mL of sterile distilled water into a bottle of 25 mg of ICG dye (Daiichi Pharmaceutical Co., Ltd., Tokyo, Japan). Subsequently, 0.1 mL of 0.25% ICG was applied to the retina at a distance twice the diameter of the papilla and away from the center of the macula in order to check for any remnant ILM, while briefly discontinuing infusion of the perfusion fluid. However, there were no longer any parts of the ILM that were stained by ICG, and the center of the macula devoid of ILM was pigmented with a deep green color immediately after a few drops of ICG were applied. Directly after post-coloration, we attempted to wash the macular region with a bal-

Figure 2. Fundus photograph, spectral-domain optical coherence tomography (SD-OCT), and autofluorescence (AF) images at postoperative 4 years. (A) Fundus photograph showed depigmentation of the macular area over long-term follow up. (B) SD-OCT image showed persistent damage on the outer retinal layer, including the photoreceptor layer and retinal pigment epithelium. (C) AF image showed the hypofluorescent area of the macula corresponding to the area with focal RPE atrophy. RPE = retinal pigment epithelium.

anced salt solution, but no reduction in the green coloration was observed.

Postoperatively at week 1, his visual acuity worsened to 20/500 with intense coloration of the macular region (Fig. 1B, C). Although coloration of the macular region seemed to fade over the following 4 years, his best corrected visual acuity did not recover to more than 20/250. Postoperative optical coherence tomography (OCT) revealed disruption of the external limiting membrane and the inner/outer segment of the photoreceptor (IS/OS) junction with retinal pigment epithelium (RPE) atrophy (Fig. 2A, B). Marked hypofluorescence of the fovea was observed on postoperative autofluorescence (AF) imaging (Fig. 2C).

Discussion

This case study indicates that the ICG dye can lead to irreversible foveal damage when applied to the bare retina devoid of the ILM. Based on the fundus photos and the AF and OCT findings, we observed toxic damage associated with RPE atrophy of the fovea. Although greater RPE atrophy was previously reported during macular hole (MH) surgery with the use of ICG [2], in this case, ICG seems to have caused toxic damage to the outer retina, even without MH.

The instantaneous coloration of the fovea suggests that there was immediate uptake of the ICG dye by the ganglion cells. Tadayoni et al. [4] suggested that ICG injected into

the vitreous cavity undergoes anterograde axonal transport after binding to the axons of ganglion cells, based on the persistent ICG fluorescence of the macular and optic nerve regions for over 3 months postoperatively. Given that the ILM consists of the foot process of ganglion cells, its removal might directly expose the ganglion cells to the vitreous cavity.

Several safety parameters for ICG dye usage have been suggested to avoid retinotoxicity [5]. The use of lower ICG concentrations and minimal incubation times, injecting the ICG dye far away from the fovea, and keeping the light pipe as far away as possible in the vitreous cavity have all been suggested. Irrespective of our adherence to these guidelines, when injected onto the bare retina, ICG caused permanent damage to the fovea. Given the role of the ILM as a barrier at the vitreoretinal interface protecting the underlying neuroretinal tissue [6], injecting ICG dye without the ILM may cause direct damage to the retinal tissue. Therefore, direct injection of the ICG to confirm the presence of remnant ILM should be performed with caution.

In summary, we presented a case study where the application of ICG onto the bare retina caused irreversible damage. ICG dye should be used with caution, as it may cause irreversible damage to the fovea.

Conflicts of interest

There are no conflicts of interest.

References

1. Burk SE, Da Mata AP, Snyder ME, et al. Indocyanine green-assisted peeling of the retinal internal limiting membrane. *Ophthalmology* 2000;107:2010-4.
2. Gass CA, Haritoglou C, Schaumberger M, Kampik A. Functional outcome of macular hole surgery with and without indocyanine green-assisted peeling of the internal limiting membrane. *Graefes Arch Clin Exp Ophthalmol* 2003;241:716-20.
3. Sheidow TG, Blinder KJ, Holekamp N, et al. Outcome results in macular hole surgery: an evaluation of internal limiting membrane peeling with and without indocyanine green. *Ophthalmology* 2003;110:1697-701.
4. Tadayoni R, Paques M, Girmens JF, et al. Persistence of fundus fluorescence after use of indocyanine green for macular surgery. *Ophthalmology* 2003;110:604-8.
5. Rizzo S, Belting C, Genovesi-Ebert F, et al. Modified technique for safer indocyanine-green-assisted peeling of the internal limiting membrane during vitrectomy for macular hole repair. *Graefes Arch Clin Exp Ophthalmol* 2006;244:1615-9.
6. Schmidt JC, Meyer CH, Rodrigues EB, et al. Staining of internal limiting membrane in vitreomacular surgery: a simplified technique. *Retina* 2003;23:263-4; author reply 264.