Sub-inner limiting membrane hemorrhage following a laser show

Hemorragia submembrana limitante interna secundaria a láser de espectáculos

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Abstract

This is the case of a 26-year-old man that presented a visual acuity decrease after unintentionally looking at a light projected in a laser show. On examination, a premacular hemorrhage was observed in the left eye. Optical coherence tomography demonstrated the presence of a sub-inner limiting membrane hemorrhage. A pars plana vitrectomy was performed with internal limiting membrane peeling, followed by rapid visual acuity improvement.

Key words: Ocular laser injury. Macular hemorrhage. Sub-internal limiting membrane hemorrhage. Laser. Retina.

Resumen

Presentación de un caso clínico de un paciente de sexo masculino de 26 años, que acude por baja visual, tras ver accidentalmente una luz proyectada por un láser de espectáculos, y que presenta una hemorragia prerretiniana en el ojo izquierdo. La tomografía de coherencia óptica mostró la presencia de una hemorragia sublimitante interna. Se le realizó una vitrectomía pars plana con pelado de la limitante interna, y se produjo una rápida mejoría de la agudeza visual.

Palabras clave: Daño ocular por láser. Hemorragia macular. Hemorragia sub-MLI. Láser. Retina.

Introduction

The development of the laser allows the availability of this technology in multiple devices used in our daily lives and in more specific applications. Most laser-associated injuries are usually related to accidents with low-power laser pointers (< 5 mW)¹. Different types of retinal lesions have been described, involving

the fovea or juxtafoveal areas such as ring-shaped hypopigmented lesions, window defects due to alterations of the retinal pigment epithelium, retinal scars, intra and subretinal hemorrhage, vitreous and premacular hemorrhage (mainly due to pulsed dye laser), and macular hole². It is important to highlight the formation of premacular hemorrhages due to serious eye damage it can

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inflict. Different forms of treatment have been described, ranging from observation to vitrectomy.

Clinical case

A 26-year-old male patient, resident of Mexico City, whose job is organizing lighting and sound shows at social events. He denied family, personal pathological and non-pathological history, and only indicates as ocular history of the use of eyeglasses since adolescence. He refers to the accidental sight of light projected by a laser console for a few seconds while he was making a purchase of equipment for the lighting show, with subsequent sudden and non-painful visual loss of the left eye of 1 day of evolution. The patient does not remember the color of the laser light.

Physical examination revealed a visual acuity in the right eye of 20/200, with a visual capacity of 20/20, and in the left eye of 20/800, with a visual capacity of 20/400; and a refraction in the right eye of $-3.00 = -1.25 \times 170^\circ$ and in the left eye of $-2.75 = -1.25 \times 180^\circ$. The anterior segment of both eyes was normal, with preserved pupillary reflexes and normal intraocular pressure. The right eye fundus was normal, while the left eye showed a macular pre-retinal hemorrhage of approximately 2 disc diameters, with an excavation of 45% of the optic nerve (Fig. 1). Fluorescein angiography showed hypofluorescence due to blockage in the left eye at the level of the hemorrhage (Fig. 2). General laboratory tests were performed, which included full blood count and chemistry panel, clotting times, and viral profile, which were all normal. A spectral-domain optical coherence tomography showed a dome-shaped lesion corresponding to a subhyaloid hemorrhage, divided by a median reflectivity line that corresponds to the internal limiting membrane, which separates the subhyaloid hemorrhage from the sub-internal limiting hemorrhage (Fig. 3). We performed a 23-gauge pars plana vitrectomy with brilliant blue-assisted internal limiting peeling. The patient had a favorable evolution, with a visual capacity in both eyes of 20/20 at 6 months of follow-up (Fig. 4).

Discussion

The first publications regarding laser injuries are associated with accidental exposure to laser in the military or laboratories. In 2004, the worldwide frequency of laser injuries was estimated to be < 15 cases³. However, due to the increased availability of commercial lasers, the frequency of these injuries has increased.

Figure 1. The right eye normal fundus photograph (A) and the left eye fundus photograph with a pre-macular hemorrhage of approximately 2 disc diameters, with an approximate excavation of 45% of the optic nerve (B).

Figure 2. Fluorescein angiography of the right eye without vascular alterations (A) and of the left eye with hypofluorescence due to blockage at the level of the hemorrhage (B).

Figure 3. Spectral-domain optical coherence tomography of the left eye, showing a dome-shaped lesion that corresponds to a subhyaloid hemorrhage, divided by a medium reflectivity line that corresponds to the internal limiting membrane and that separates the subhyaloid hemorrhage from the sub-internal limiting hemorrhage.

Although laser injuries can be bilateral, most of them are unilateral because they occur at short distances⁴, accidentally or also self-inflicted with laser pointers, whose output power is usually 1-5 mW. More serious injuries have been associated with Q-switched lasers⁴⁻⁶. Blink reflex and aversion response limit exposure time to 0.15-0.25 s². With short wavelengths and prolonged exposure, tissue damage

Figure 4. Fundus photography **A:** and spectral-domain optical coherence tomography **B:** of the left eye 6 months after treatment, where a decrease in foveal depression and irregularity of the internal layers in the temporal region are observed, without pre-retinal hemorrhage.

has been shown to be greater, even with a low-power laser⁷⁻⁹.

The retina is the ocular tissue most sensitive to laser injury due to the focus of light and irradiation that is amplified by 5-6 orders of magnitude. Chromatic aberration and mild myopia produce an anterior focus for the laser that also increases the susceptibility of the retina¹⁰.

The macula is especially susceptible, due to the greater absorption of laser energy due to the presence of pigments such as melanin, xanthophyll pigment, and hemoglobin¹⁰.

The mechanisms through which the laser exerts its action are the photochemical effect, photoablation, photocoagulation, and optical photodisruption; both photocoagulation and optical photodisruption are the ones that disrupt retinal vessels and produce self-limited bleeding¹¹.

In Mexico, there are no organizations that regulate the manufacture of commercial lasers, which has produced an increase in the occurrence of cases¹². Associations such as the American National Standard for Safe Use of Lasers classify them based on their safety as potentially harmful to the eye when the output power is > 5 mW, and capable of producing serious eye damage when the output power is more than 500 mW. They also establish the maximum permissible exposure of 25.4 W/m^2 for a period of 250 ms, equivalent to 1 mW in a pupil diameter of 7 mm^{13,14}.

Commercially available lighting show lasers are typically 800 mW-3 W in power, typically have blanking scanners or other scanning systems for complex beam and graphic projections¹¹. In this case, the patient did not know the color and power of the laser; however, due to the disease mechanism and the type of laser consoles used in shows, it is considered that it could

have been a class 3B laser, commonly used for shows; a green laser with a 50 mW power (with a wavelength of around 532 nm) or a red laser with a 120 mW power (with a wavelength of around 650 nm).

The goal of treatment is to eliminate the hemorrhage¹⁵ and prevent complications, such as membrane formation and proliferative vitreoretinopathy¹⁶, as well as destructive toxic effects to the tissue from prolonged exposure. It should be remembered that the left sub-internal limiting membrane hemorrhage tends to remain longer than the subhyaloid hemorrhage¹⁷.

Different treatment options have been used, such as observation^{2,11,18}; however, it requires close monitoring and, the greater the hemorrhage, the slower the reabsorption is, and not all patients regain their visual capacity¹⁹. The YAG laser allows the drainage of blood into the vitreous cavity and is reabsorbed in an average of 6 weeks. It is recommended for hemorrhages > 3 disc diameters, but its association with a macular hole has limited its use^{2,20}. Vitrectomy with or without internal limiting membrane peeling has shown to induce a significant and immediate visual improvement and can prevent complications such as amblyopia or myopia in children, as well as those derived from the lack of an adequate evaluation of the deeper layers^{2,12,20}. Other techniques such as hemolysis and pneumodisplacement have been described¹⁵; however, they require the use of drugs that are difficult to handle and are mainly described for the treatment of subretinal hemorrhages.

Conclusion

Lasers can cause serious eye damage. The increase in cases, especially in our environment, reiterates the importance of regulating the use and commercialization of lasers not only the pointers but also those used in our daily life. Vitrectomy is an effective technique for the resolution of premacular hemorrhages with few complications.

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Conflicts of interest

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Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

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