American Journal of Ophthalmology Case Reports 42 (2026) 102554

Contents lists available at ScienceDirect

American Journal of Ophthalmology Case Reports

journal homepage: www.ajocasereports.com/

Combat high-intensity light–induced full-thickness macular hole: A case report

Mykola Umanets [a], Yevhenii Chumakov [a,*], Nataliya Pasyechnikova [b]

[a] State Institute «the Filatov Institute of Eye Diseases and Tissue Therapy of the National Academy of Medical Sciences of Ukraine», Department of Retinal and Vitreous Pathology, Ukraine
[b] State Institute «the Filatov Institute of Eye Diseases and Tissue Therapy of the National Academy of Medical Sciences of Ukraine», Ukraine

ARTICLE INFO

Keywords:
High-intensity light
ILM flap
Macular hole
Photic injury
Vitrectomy

ABSTRACT

Purpose: This case report aims to present a unique case of high-intensity light–induced full-thickness macular hole in a soldier, which was managed with vitrectomy and internal limiting membrane (ILM) double flap.
Observations: A patient presented with decreased visual acuity and central scotoma after gazing at the spotlight of the air defense system. Both ophthalmoscopy and optical coherence tomography (OCT) were used to visualize the macula and diagnose the macular hole. The best-corrected visual acuity (BCVA) at admission to the clinic was 0.12 (20/160) eccentric. The full-thickness macular hole measured 534 μm in diameter on OCT. The patient was treated using 25-G vitrectomy with ILM double flap and intraocular gas (15% perfluoropropane) tamponade, followed by postoperative head-down positioning. The surgery successfully achieved macular hole closure with partial restoration of photoreceptors on OCT. The postoperative BCVA was 0.25 (20/80) at 1 month.
Conclusions and importance: Therefore, although rarely observed, high-intensity light can cause full-thickness macular hole among soldiers, which can be successfully managed with vitrectomy and ILM double flap. Wearing protective equipment during potential light exposure by military personnel is mandatory to prevent such injuries.

1. Introduction

Photic retinopathy is an umbrella term representing the damage to outer segments of photoreceptors and retinal pigment epithelium (RPE), sometimes leading to their destruction and even full-thickness tissue defect (macular hole).[1,2] First case reports of photic retinopathy by McDonald and Irvine included prolonged low-intensity light exposure to the operation microscope, documenting the detrimental effect of visible light in certain conditions.[2] The incidence of photic maculopathy is rare.[3] Despite its rarity, photic macular injury represents a significant issue, especially in circumstances of increased risks for photic retinal damage, such as military conflicts with the potential use of lasers and high-intensity light devices. Therefore, the current case report aims to present and discuss a unique case of photic macular hole induced by high-intensity light exposure by military personnel during the war in Ukraine.

2. Case report

2.1. Initial assessment

This case report describes a 25-year-old male patient who presented to our clinic with decreased vision in the left eye. The patient provided written informed consent for treatment in the clinic and subsequent study publication. The patient noted visual loss after exposure to high-intensity light during military service (the patient gazed directly at the spotlight of the air-defense system). Three months after the incident, he was referred to our institute. The best-corrected visual acuity (BCVA) of both eyes was assessed using a decimal system (with Snellen chart visual acuity provided for comparison). The patient's BCVA of the left eye at admission was 0.12 (20/160) eccentric. The right eye was unaffected. Ophthalmoscopically, a macular defect was visible, suggesting a full-thickness macular hole. Optical coherence tomography (OCT) on admission showed a full-thickness macular hole 534 μm in diameter (Fig. 1A). OCT images were obtained using REVO NX SOCT (Optopol Technology, Zawiercie, Poland). The macular hole diameter was measured as the minimum horizontal diameter within the hole on the

* Corresponding author.
E-mail address: yevhenii_chumakov@icloud.com (Y. Chumakov).

https://doi.org/10.1016/j.ajoc.2026.102554
Received 7 October 2025; Received in revised form 22 January 2026; Accepted 2 March 2026
Available online 9 March 2026

Glossary

BCVA	best-corrected visual acuity
ILM	internal limiting membrane
OCT	optical coherence tomography
PPV	pars plana vitrectomy
RPE	retinal pigment epithelium

macular thickness horizontal scan. Fluorescein angiography, performed following a standard protocol, showed foveal hyperfluorescence, indicating a window defect, i.e., photic retinal pigment epithelium injury (Fig. 2).

2.2. Surgical procedure

The patient underwent a 25-G vitrectomy, ILM double flap, and intraocular gas (15% perfluoropropane) tamponade with postoperative head-down positioning. A single surgeon performed the operation. After sub-Tenon anesthesia (4.0 ml 2% lidocaine), three 25-gauge cannulas were placed. Then, pars plana core vitrectomy (PPV), as well as posterior hyaloid membrane detachment and removal, were performed using the Alcon Constellation system (Alcon Laboratories, Inc., Fort Worth, TX) and a wide-field visualization system. Following internal limiting membrane (ILM) staining with 0.18% Trypan Blue + 0.03% Blulife (TWIN, Alchimia, Viale Austria, Ponte San Nicolo, Italy) dye solution, a double flap (temporal and nasal flap with attached superior and inferior ILM portions) was created with ILM forceps and placed on the macular hole. The procedure was finished with fluid-air exchange and subsequent tamponade with 15% perfluoropropane. Then, the cannulas were removed, followed by a dexamethasone subconjunctival injection.

2.3. Postoperative care

The surgery successfully achieved macular hole closure (Fig. 1B). The patient maintained positioning after the surgery and was examined daily during the hospitalization. Postoperative treatment included a standard regimen, comprising topical cycloplegic (0.8% tropicamide and 5% phenylephrine), steroid (0.1% dexamethasone), antibiotic (0.3% tobramycin), and non-steroidal anti-inflammatory (0.09%

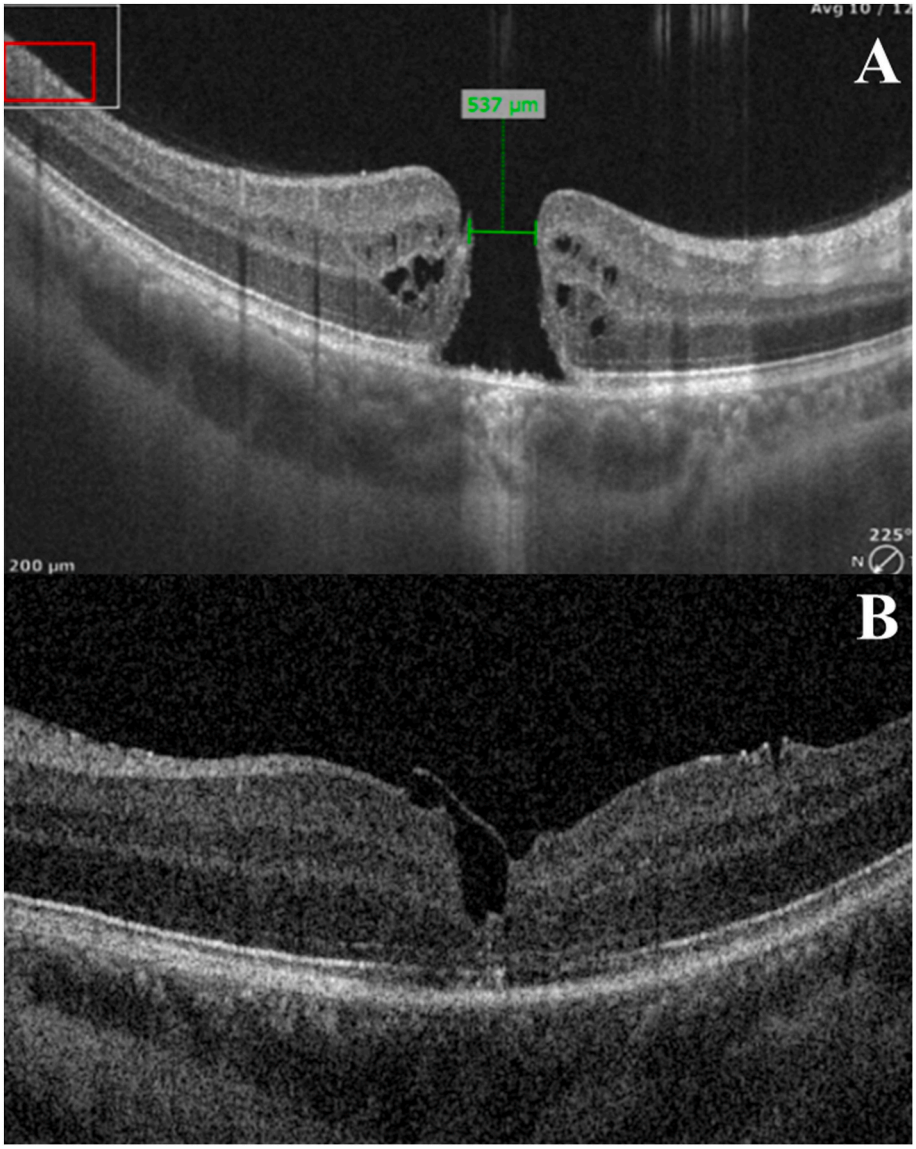

Fig. 1. Preoperative and postoperative optical coherence tomography images of the left eye. (A) Preoperative optical coherence tomography image, demonstrating the macular hole and its diameter. (B) Postoperative optical coherence tomography image at 1 month post-surgery, demonstrating successful macular hole closure.

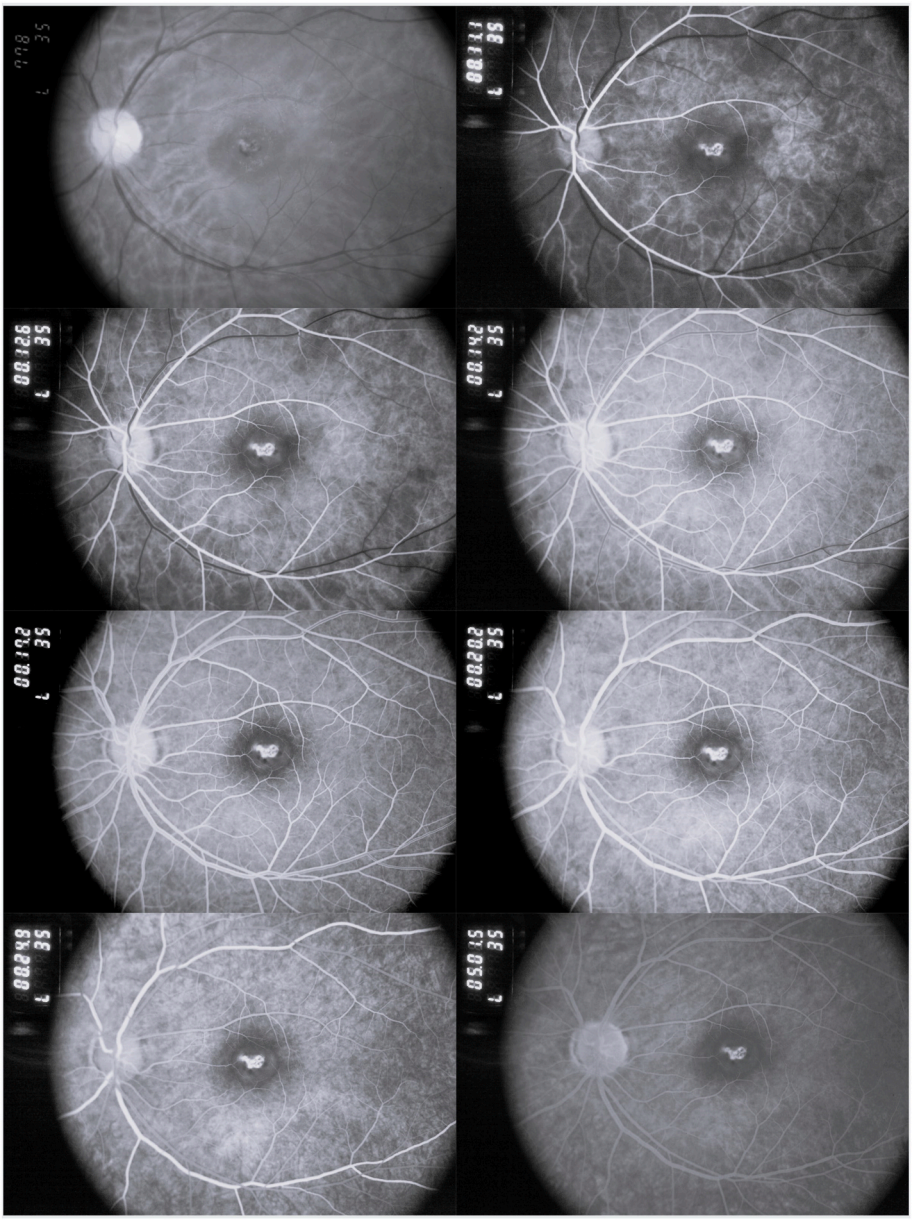

Fig. 2. Fluorescein angiography of the left eye. The images demonstrate a window defect in the foveal retinal pigment epithelium as a result of high-intensity light injury.

bromfenac), and artificial tear (0.4% hyaluronic acid) eye drops. At the 1-month follow-up after the surgery, the BCVA of the affected eye improved to 0.25 (20/80; an improvement by 15 letters on the Early Treatment Diabetic Retinopathy Study letter score).

3. Discussion

Visible light can cause significant damage to the retina, specifically photoreceptors and RPE.[1,2] The duration and nature of light exposure are the determinants of retinal damage extent, ranging from minimal changes in the photoreceptors to cell destruction.[4] Cenovicz et al. reported that relatively mild-to-moderate cases of photic maculopathy are characterized by the outer retinal hole.[3] Maganti et al. showed that the fovea is more susceptible to photic injury since it is thin and comprises mainly of RPE cells that absorb light energy through melanin 5. Moreover, Seet and Wong suggested that the eye is especially vulnerable to high-intensity light owing to its reflex fixation response that directs the gaze toward a visible light source.[6] Furthermore, the refractive media and optical devices (e.g., binoculars or glasses) focus the light rays on the small retinal spot, increasing the risk of macular injury.[7] Therefore, wearing protective equipment is recommended to mitigate those risk factors and decrease retinal damage.[5]

The photic full-thickness macular hole in our case is somewhat similar to laser-induced and solar maculopathy. Apparently, photothermal and photomechanical damage plays a crucial role in such cases. Photothermal damage is caused mostly by the light at the upper end of the visible spectrum and near-infrared light, during which melanin in the RPE absorbs light energy, raising the local temperature and destroying retinal cells through protein denaturation.[8] As for photomechanical damage, high-intensity short-term light (e.g., Nd:YAG and pulsed lasers) creates microcavitation bubbles in the RPE and other retinal cells, eventually destroying the retinal tissue.[8–10] Thus, the most probable mechanism involved in our case is photomechanical damage, with limited influence of photothermal and photochemical effects.

Maganti et al. reported the only case of the macular hole due to intense pulsed light therapy, involving a similar mechanism as in our

case.[5] Wang et al. also reported macular hole formation due to phototoxicity, although with lasers.[10] Considering the current war in Ukraine and the frequent use of spotlights in the air-defense system, the incidence of light-induced injury might increase. Moreover, the current literature has not yet reported any cases of combat photic macular holes. Thus, combat photic injury, including photic full-thickness macular hole, might represent a significant novel issue for ophthalmologists.

This case was successfully managed with surgery, as in more frequent cases of full-thickness macular hole of other etiology. Maganti et al. performed PPV with ILM peeling and gas tamponade for high-intensity light–induced full-thickness macular holes, which is somewhat similar to our approach.[5] However, the case of Maganti et al. involved a small-diameter hole that could not close spontaneously; thus, surgery was required.[5] Large full-thickness macular holes (>400 μm in diameter) are unlikely to close spontaneously, requiring surgical intervention.[11] Moreover, ILM flap techniques allowed for achieving higher closure rates for large idiopathic full-thickness macular holes.[11] Therefore, considering the current knowledge on full-thickness macular hole treatment and the unique etiology in our case, we chose to perform PPV with ILM double flap to achieve the best possible outcomes. Although we achieved anatomical closure, the functional recovery was limited. This might be related to (1) the long interval between macular hole development and treatment and (2) decreased functional capacity of the retinal pigment epithelium and retina due to extensive injury to these structures.

In conclusion, this case demonstrates the potential hazard of military service exposure to high-intensity light from the spotlights of the air defense system. While mild-to-moderate damage results only in outer retinal tissue destruction, more severe damage might lead to a full-thickness macular hole, mainly through the photomechanical effect. This unique case was successfully managed using PPV, ILM double flap, and gas tamponade with head-down positioning. Additionally, this case underlines the necessity for wearing protective equipment (i.e., glasses) during military service with potential exposure to high-intensity light.

CRediT authorship contribution statement

Mykola Umanets: Writing – review & editing, Writing – original draft, Visualization, Supervision, Investigation, Conceptualization. **Yevhenii Chumakov:** Writing – review & editing, Writing – original draft, Visualization, Investigation, Conceptualization. **Nataliya Pasyechnikova:** Writing – review & editing, Visualization, Supervision, Investigation, Conceptualization.

Patient consent

The patient provided informed consent to publish this case report. This report does not contain any personal identifying information.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Funding

No funding or grant support was provided for this study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

References

1. Begaj T, Schaal S. Sunlight and ultraviolet radiation—pertinent retinal implications and current management. *Surv Ophthalmol*. 2018;63:174–192. https://doi.org/10.1016/j.survophthal.2017.09.002.
2. McDonald HR, Irvine AR. Light-induced maculopathy from the operating microscope in extracapsular cataract extraction and intraocular lens implantation. *Ophthalmology*. 1983;90:945–951. https://doi.org/10.1016/s0161-6420(83)80022-0.
3. Cenovicz MS, Robaina GG, Zanatta AL, Moreira Neto CA. Photic maculopathy: five case reports and literature review. *Rev Bras Oftalmol*. 2024;83, e002. https://doi.org/10.37039/1982.8551.20240021.
4. Kuwabara T, Gorn RA. Retinal damage by visible light: an electron microscopic study. *Arch Ophthalmol*. 1968;79:69–78. https://doi.org/10.1001/archopht.1968.03850040071019.
5. Maganti N, Kalbag NS, Gill MK. Macular hole formation associated with intense pulsed light therapy. *Retin Cases Brief Rep*. 2022;16:161–164. https://doi.org/10.1097/icb.0000000000000947.
6. Seet B, Wong TY. Military laser weapons: current controversies. *Ophthalmic Epidemiol*. 2001;8:215–226. https://doi.org/10.1076/opep.8.4.215.1610.
7. Badiuk M, Zhupan BB, Khramov II, Mykyta OO. Medical and social features of laser eye injuries in military personnel of the Defense Forces of Ukraine. *World Med Biol*. 2023;3:25–30. https://doi.org/10.26724/2079-8334-2023-3-85-25-30.
8. Youssef PN, Sheibani N, Albert DM. Retinal light toxicity. *Eye (Lond)*. 2011;25:1–14. https://doi.org/10.1038/eye.2010.149.
9. Saleem Z, Scoles D, Capone Jr A, Mahmoud TH. Iatrogenic macular hole because of neodymium:yttrium-aluminum-garnet-selective laser trabeculoplasty laser: case report and management. *Retin Cases Brief Rep*. 2025;19:91–94. https://doi.org/10.1097/icb.0000000000001517.
10. Wang X, Zhang T, Jiang R, et al. Vitrectomy for laser-induced full-thickness macular hole. *BMC Ophthalmol*. 2021;21:135. https://doi.org/10.1186/s12886-021-01893-8.
11. Riding G, Teh BL, Yorston D, Steel DH. Comparison of the use of internal limiting membrane flaps versus conventional ILM peeling on post-operative anatomical and visual outcomes in large macular holes. *Eye*. 2024;38:1876–1881. https://doi.org/10.1038/s41433-024-03024-1.