

Nd:YAG laser membranotomy in treatment of pre-macular hemorrhage in Valsalva retinopathy



**Angelina Papeczyc, Daniel Czyżewski, Adam Chmiel,
Małgorzata Frankowska-Gierlak**

Department of Ophthalmology, National Medical Institute of the MSWiA in Warsaw

Head: Joanna Sempirńska-Szewczyk, MD, PhD

HIGHLIGHTS

Nd:YAG laser membranotomy is a safe and effective method for treating pre-macular hemorrhage in Valsalva retinopathy.

ABSTRACT

A 37-year-old patient was admitted to the ophthalmology department due to sudden vision deterioration in the right eye, preceded by vomiting two days earlier. Visual acuity was found at the level of counting fingers at 3 m. Fundus examination revealed a large pre-macular hemorrhage covering the entire area between the arcades. Based on clinical presentation, history, and imaging studies, a diagnosis of Valsalva retinopathy was made. With the patient's consent, Nd:YAG laser treatment was performed on the lower part of the hemorrhage, resulting in blood displacement into the vitreous body and significant improvement in visual acuity to 0.6 BVCA immediately post-procedure.

Key words: Valsalva retinopathy, pre-macular hemorrhage, Nd:YAG laser membranotomy, sudden vision loss

INTRODUCTION

Pre-macular hemorrhage is characterized by blood accumulation between the internal limiting membrane (ILM) of the retina and the posterior hyaloid membrane or between the ILM and the nerve fiber layer (NFL). It occurs in various systemic diseases and ocular conditions, including Valsalva retinopathy [1, 2]. Valsalva retinopathy is a specific form characterized by pre-retinal hemorrhages secondary to superficial retinal capillary damage due to a sudden increase in venous pressure in the chest and abdominal cavities (e.g., weightlifting, balloon blowing) [3]. Incompetent venous valves may allow pressure transmission to the head and neck vessels [4].

Treatment options include observation, Nd:YAG laser membranotomy (ILM and posterior hyaloid membrane), pars plana vitrectomy (PPV), intravitreal gas injection, and recombinant tissue plasminogen activator (rt-PA). Compared to PPV, which is more invasive and carries a risk of complications, Nd:YAG membranotomy is a relatively safe and effective method for draining pre-macular hemorrhage into the vitreous chamber. This paper presents a case of effective treatment of sub-ILM hemorrhage using the Nd:YAG laser for Valsalva retinopathy, confirmed by wide-angle optical coherence tomography imaging [5].

MATERIALS AND METHODS

A 37-year-old patient was admitted to the ophthalmology department due to sudden vision deterioration in the right eye, preceded by vomiting 2 days earlier. The patient had no history of trauma, surgery, or ocular diseases, nor reported chronic diseases or systemic infections preceding the hemorrhage. Visual acuity was at the level of finger counting from 3 m. Intraocular pressure was 17 mmHg. Anterior segment examination in both eyes was normal. Fundus examination revealed a large pre-macular hemorrhage with a blood level covering the entire area between the arcades, measuring 6DD (fig. 1, 2).

RESULTS

Based on the clinical presentation, history, and imaging studies, Valsalva retinopathy was diagnosed. On the day of admission, with patient consent, Nd:YAG laser treatment (Tango Reflex with VOLK Singh Mid Vitreous lens) was performed. The first laser impact at 5 mJ in the lower part of the hemorrhage resulted in ILM rupture and blood displacement under the posterior hyaloid membrane (fig. 3A). A second 5 mJ laser impact caused local posterior hyaloid membrane rupture and blood displacement into the vitreous body (fig. 3B), improving visual acuity to 0.6 BVCA. The anatomical location of the fovea is about 500 μm below the horizontal line passing through the center of the optic

FIGURE 1

Fundus photo showing a large pre-retinal hemorrhage between the vascular arcades covering the macula with a blood level.



disc. Laser impact should be placed no closer than 1000 μm from the fovea to avoid damage. The impact site was chosen along the lower edge of the hemorrhage, at a safe distance from healthy retina. The lowest possible location of Nd:YAG membranotomy allows gravitational blood flow into the vitreous chamber, leaving minimal blood in the ILM-detached area. Figure 3B shows residual dispersed blood below the impact site. Literature confirms that properly performed membranotomy leads to dynamic blood drainage from the hemorrhage area [6].

On the first day post-procedure, visual acuity in the left eye was 0.8 BVCA. Fundus examination showed dispersed blood in the vitreous body with significant clearing of the pre-macular area (fig. 4). Two days post-procedure, visual acuity improved to 0.9 BVCA with a similar fundus appearance. One month later, visual acuity reached 1.0 BVCA with complete blood absorption in the vitreous body and no complications. Spectralis OCT showed ILM detachment above the macula without epiretinal membrane features (fig. 5).

DISCUSSION

Pre-macular hemorrhage in Valsalva retinopathy can lead to sudden and significant vision loss, potentially persisting if not properly treated. In healthy patients, such clinical presentations occur during various activities like vomiting,

FIGURE 2

Wide-angle OCT showing the shadow effect of the pre-macular hemorrhage covering the macula, obscuring the underlying retina and subretinal space.

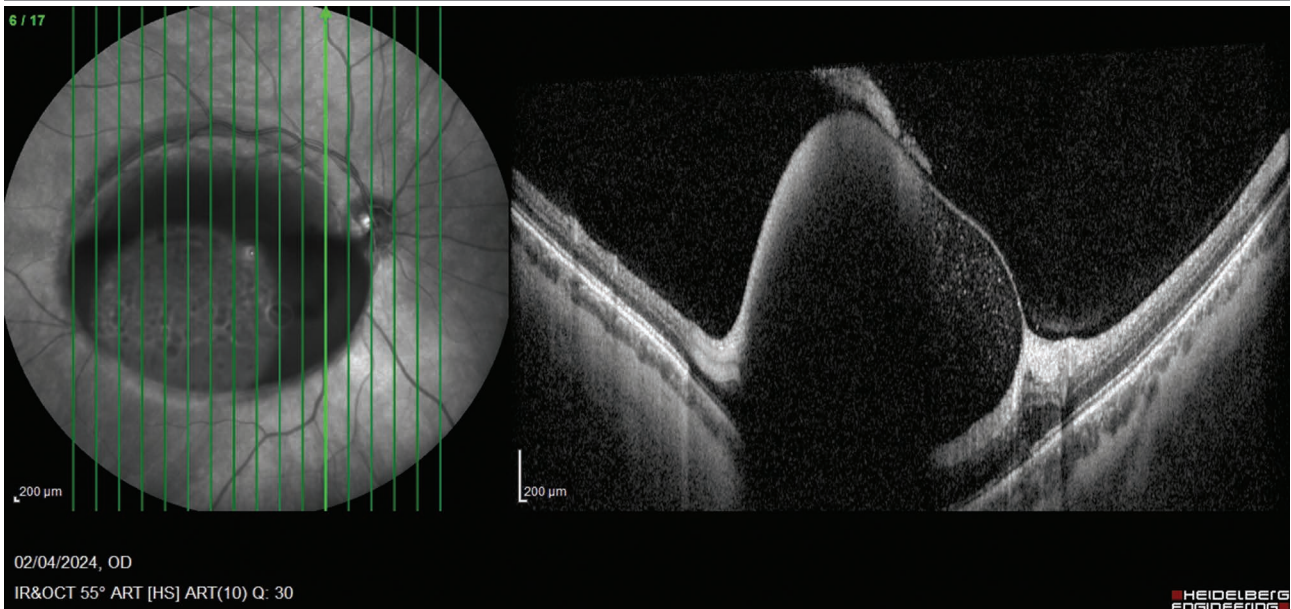
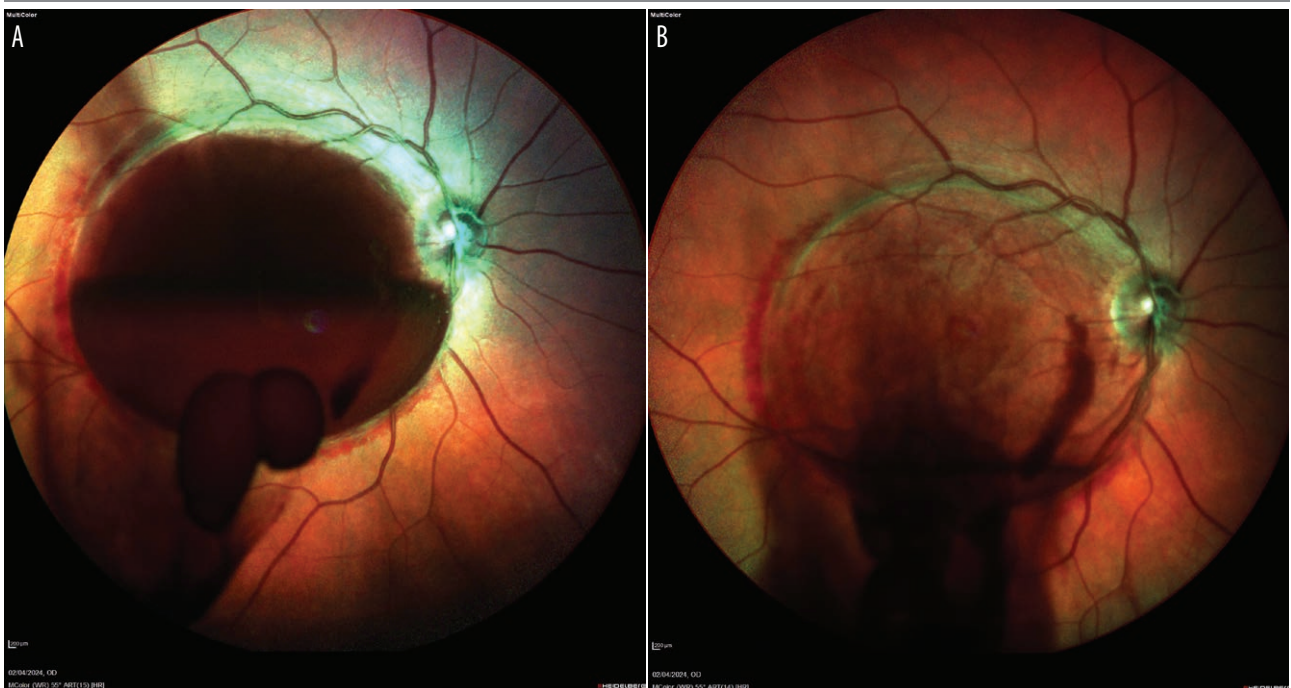


FIGURE 3

Fundus photos post Nd laser membranotomy. A. ILM rupture and hemorrhage displacement under the posterior hyaloid membrane. B. Hemorrhage draining into the vitreous body.



sexual activity, physical exercise, balloon blowing, or childbirth. While spontaneous resolution of the hemorrhage often occurs, its duration can vary from weeks to months, depending on the hemorrhage size [3, 7]. Additionally, there is a risk of permanent vision damage due to the de-

velopment of an epiretinal membrane and potential retinal damage from prolonged exposure to hemoglobin and iron toxicity [5].

In this type of hemorrhage, blood accumulates under the ILM or the posterior hyaloid membrane [5]. If hemorrhage

FIGURE 4

One day post-procedure. Fundus photo showing dispersed blood in the vitreous body.



dome-shaped, and may sometimes show a light reflex from the ILM covering the hemorrhage. Currently, accurate hemorrhage localization can only be determined intraoperatively, complicating treatment method choice.

Treatment of pre-macular hemorrhage includes intravitreal gas injection, rt-PA with gas, pars plana vitrectomy, or Nd:YAG laser membranotomy [5, 9, 10]. Nd:YAG laser is used for treating pre-macular hemorrhages in conditions such as Valsalva retinopathy, proliferative diabetic retinopathy, retinal artery macroaneurysm, branch retinal vein occlusion, especially when the hemorrhage surface exceeds 3 optic disc diameters, and its duration is under 3 weeks [3]. Nd:YAG laser impact causes rapid dispersion of pre-macular hemorrhage, restoring visual function without more invasive methods [5]. Complications are rare but can include vitreous hemorrhage (early), epiretinal membrane, or macular hole (late) [11].

Best treatment results are achieved with laser impact along the lower hemorrhage edge, ensuring rapid blood evacuation into the vitreous body under gravity. The laser impact should be at a safe distance from the fovea to avoid damage [11]. In this case, quick diagnosis using wide-angle optical coherence tomography and subsequent Nd:YAG laser treatment with two 5 mJ impacts first ruptured the ILM,

FIGURE 5

One month post-procedure. Photo showing ILM detachment above the macula without epiretinal membrane features.



is present in both spaces, a “double ring” sign appears, with the outer ring corresponding to retrohyaloid space bleeding and the inner ring to sub-ILM bleeding [8]. Diagnosing the hemorrhage type accurately is often challenging. Sub-ILM hemorrhages are immobile, sharply demarcated,

then the posterior hyaloid membrane, rapidly displacing blood into the vitreous body, and improving visual acuity to 0.9 BCVA on the second day post-procedure.

CONCLUSION

Nd:YAG laser membranotomy is a safe and effective method for treating pre-macular hemorrhage in Valsalva retinopathy. It allows for quick vision improvement without

exposing the patient to the risks and prolonged recovery associated with intraocular surgical procedures like pars plana vitrectomy.

Figures: from authors' own materials.

CORRESPONDENCE

Angelina Papezcyc, MD

Department of Ophthalmology, National Medical Institute of the MSWiA in Warsaw
02-507 Warszawa, ul. Wołoska 137
e-mail: angelina.papezcyc@cskmswia.gov.pl

ORCID

Angelina Papezcyc – ID – <http://orcid.org/0009-0003-7619-9167>
Daniel Czyżewski – ID – <http://orcid.org/0000-0002-5012-4840>
Adam Chmiel – ID – <http://orcid.org/0009-0001-3154-8656>
Małgorzata Frankowska-Gierlak – ID – <http://orcid.org/0000-0001-9420-9902>

References

1. De Maeyer K, Van Ginderdeuren R, Postelmans L. Sub-inner limiting membrane haemorrhage: Causes and treatment with vitrectomy. *Br J Ophthalmol.* 2007; 91: 869-72. <https://doi.org/10.1136/bjo.2006.109132>.
2. Forshaw TRJ, Solborg Bjerrum S, Larsen M. Valsalva retinopathy in the absence of Valsalva manoeuvre: A variant of haemorrhagic unilateral retinopathy. *Acta Ophthalmologica.* 2023; 102: 122-3. <https://doi.org/10.1111/aos.15781>.
3. Durukan AH, Kerimoglu H, Erdurman C. Long-term results of Nd:YAG laser treatment for premacular subhyaloid haemorrhage owing to Valsalva retinopathy. *Eye.* 2006; 22: 214-8. <https://doi.org/10.1038/sj.eye.6702574>.
4. Duane TD. Valsalva Hemorrhagic Retinopathy. *Am J Ophthalmol.* 1973; 75: 637-42. [https://doi.org/10.1016/0002-9394\(73\)90815-5](https://doi.org/10.1016/0002-9394(73)90815-5).
5. Khadka D, Bhandari S, Bajimaya S. Nd:YAG laser hyaloidotomy in the management of Premacular Subhyaloid Hemorrhage. *BMC Ophthalmology.* 2016; 16: 41. <https://doi.org/10.1186/s12886-016-0218-0>.
6. Malov IA. Yag-laser hyaloidotomy in the treatment of premacular hemorrhages. *Reflection.* 2019; 8: 28-31. <https://doi.org/10.25276/2686-6986-2019-1-28-31>.
7. Waikar S, Srivastava VK. Valsalva retinopathy in a young healthy individual. *Med J Armed Forces India.* 2013; 69: 193-5. <https://doi.org/10.1016/j.mjafi.2012.04.015>.
8. Mathew DJ, Sarma SK. Valsalva retinopathy with double ring sign: Laser membranotomy for twin bleeds. *Saudi J Ophthalmol.* 2016; 30: 68-70. <https://doi.org/10.1016/j.sjopt.2015.10.003>.
9. Kováčová M, Kousal B, Mališka M. Treatment Options for Premacular and Sub-Internal Limiting Membrane Haemorrhage. *Cesk Slov Oftalmol.* 2021; 77: 288-92. <https://doi.org/10.31348/2021/34>.
10. Wu T-T, Kung Y-H, Lin C-S. Non-vitreotomizing vitreous surgery and adjuvant intravitreal tissue plasminogen activator for non-recent massive premacular hemorrhage. *J Chin Med Assoc.* 2011; 74: 574-8. <https://doi.org/10.1016/j.jcma.2011.08.007>.
11. Ulbig MW. Long-term Results After Drainage of Premacular Subhyaloid Hemorrhage Into the Vitreous With a Pulsed Nd:YAG Laser. *Arch Ophthalmol.* 1998; 116: 1465. <https://doi.org/10.1001/archoph.116.11.1465>.

Authors' contributions:

Angelina Papezcyc – conception and design of the study or data acquisition or analysis and interpretation of data, critical corrections.
Daniel Czyżewski – conception and design of the study or data acquisition or data analysis and interpretation, critical corrections.
Adam Chmiel – editing the article, critical corrections.
Małgorzata Frankowska-Gierlak – final approval.

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Ethics:

The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.