

Long-term results of Nd:YAG laser treatment for premacular subhyaloid haemorrhage owing to Valsalva retinopathy

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Abstract

Aims Valsalva retinopathy produces sudden visual loss, which may be prolonged if untreated. Nd:YAG laser enables rapid diffusion of premacular subhyaloid haemorrhage. This study was performed to assess the long-term results and safety of Nd:YAG laser treatment in cases with Valsalva retinopathy.

Methods Sixteen patients had Nd:YAG laser treatment to drain premacular haemorrhage. The follow-up period was 24 months.

Results All eyes had marked clearing of haemorrhage and immediate improvement of vision following laser treatment. In 14 eyes visual acuity improved to 20/20 level at the end of the first week and the remaining two patients achieved 20/20 level within 1 month. No patient had evidence of retinal or choroidal damage.

Conclusion Nd:YAG laser treatment for Valsalva retinopathy is an effective, non-invasive, and safe procedure for patients with a premacular subhyaloid haemorrhage larger than 3 disc diameter and no longer than 3 weeks of duration.

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Introduction

The Valsalva maneuver comprises forcible exhalation against the closed glottis and produces a sudden increase in the venous blood pressure owing to a rise in intrathoracic or intraabdominal pressure. As the sudden rise in

intraocular venous pressure occurs, a spontaneous rupture of retinal perifoveal capillaries ensues, leading to a sudden, painless loss of vision in an otherwise healthy eye.¹ Although unilateral manifestations are most commonly seen, it may present in both eyes. The haemorrhage typically occurs at the macula and, in the vast majority of cases, resolves spontaneously without compromising visual acuity. Generally, it is an isolated and self-limited event but even a small premacular haemorrhage of 1 DD (disc diameter) may take several months to clear.²

The most common presenting symptom is blurred vision or a central scotoma but patients with a gross preretinal haemorrhage may present with a complete loss of vision.³

Reported causes of a Valsalva maneuver include straining and physical activities, most commonly during coughing, weight lifting, vomiting, aerobic exercise, sexual activity, end-stage labour, dental procedures, colonoscopy procedures, constipation, blowing musical instruments, and compressive injuries.^{3–11}

Nd:YAG laser treatment is a non-invasive method, which enables the drainage of the extensive premacular subhyaloid haemorrhage into the vitreous, facilitates absorption of blood cells and improves the vision within days by clearance of the obstructed premacular area.

There are several reports presenting results of Nd:YAG laser treatment in series of patients with premacular subhyaloid haemorrhage of different etiologies including Valsalva retinopathy, macroaneurysms, retinal vein occlusions, and diabetic retinopathy most of which have limited number of selected cases

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and a short period of follow-up.^{12–20} Eyes with Valsalva retinopathy fared the best among the other etiologic factors owing to lack of any underlying retinal pathology.²¹ Most of the patients with Valsalva retinopathy are young and otherwise healthy and are seeking a rapid visual restoration in order to be able to continue working. In this study we investigated the effectiveness and safety of Nd:YAG laser drainage of premacular subhyaloid haemorrhage owing to Valsalva retinopathy in a private series with a longer follow-up.

Materials and methods

Seventeen eyes of 17 patients enrolled for the prospective study each with a circumscribed premacular subhyaloid haemorrhage owing to Valsalva maneuver and treated with the Nd:YAG laser to drain the entrapped blood into the vitreous. The laser procedures were performed between January 2001 and January 2004 at the Retina Service of Gulhane Military Medical Academy, Ankara, Turkey.

Patients were included if; the duration of the haemorrhage was not longer than 1 month, the diameter of the haemorrhage was not less than 4 DD, there was no significant media opacities or vitreous haemorrhage to preclude the use of the Nd:YAG, and there was no history of blunt ocular trauma or ocular etiology for subhyaloid haemorrhage. In one patient, a retinal macroaneurism was identified after resolution of premacular haemorrhage and the patient was excluded from the study. Blood pressures, complete blood count, glucose tolerance test, prothrombin time, activated partial thromboplastin time, hemoglobin electrophoresis, and urinalysis were studied for each patient to rule out any predisposing risk factors, including diabetes, hypertension, sickle cell disease, anaemia, and other blood dyscrasias. All patients provided informed consent before the treatment.

Pretreatment and post-treatment examinations of the 16 patients included best-corrected visual acuity, fundus photography, slit-lamp biomicroscopy with +90D lens for posterior pole, and indirect ophthalmoscopy for retinal periphery. Florescein angiography was performed in selected patients. The horizontal and vertical diameters of the preretinal haemorrhage were measured in DDs and averaged (Figure 1a and c).

All laser treatments were carried out with the patient under topical anaesthesia with the use of benoxinate hydrochloride eye drops. The pupil was dilated with 1% tropicamide and 1% cyclopentolate before the procedure. A Zeiss Visulag system Nd:YAG laser and a Goldmann three-mirror contact lens was used for focusing with a slit-lamp delivery system. The laser was operated in the Q-switched mode and single bursts were emitted. Laser

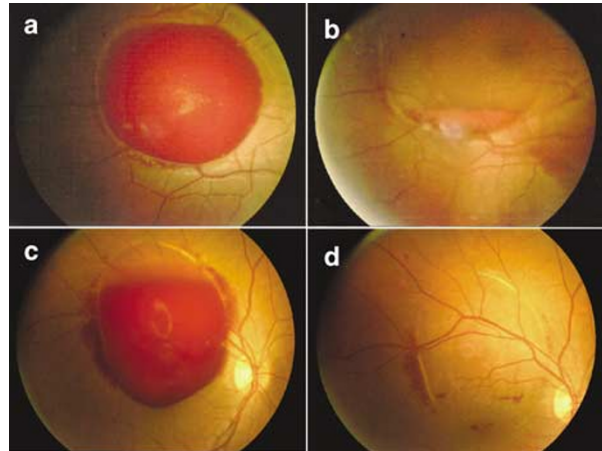


Figure 1 Pre and post-treatment photographs of patients 11 and 12. (a) Patient 11 with premacular haemorrhage of 3 days duration. (b) Dispersion of haemorrhage into the vitreous gel 24 h after performing the Nd:YAG laser treatment. (c) Right eye of patient 12 with premacular haemorrhage of 5 days duration. (d) Fundus photograph 1 week after Nd:YAG laser treatment showing resolution of the premacular haemorrhage and the clear vitreous gel.

exposures were started with low energies and then gradually increased until a perforation became visible. The power required varied from 2.2 up to 9.7 mJ. The puncture was made on the surface of the premacular subhyaloid haemorrhage at a location distant from the fovea and retinal blood vessels but with a sufficient thickness of blood to protect the underlying retina. The aiming beam was precisely focused at the inferior edge of the subhyaloid haemorrhage to facilitate a gravity-induced drainage (Figure 1b).

None of the patients needed further surgical intervention. All the patients were seen on the next day and then followed up in the first week, first month, third month, sixth month, and with 6-month periods up to 2 years.

Results

Twelve patients were male and four were female. Their ages ranged from 20 to 53 years and the period of follow-up was 24 months (Table 1). All of the patients were diagnosed as Valsalva retinopathy by eliminating the other causative factors and with a history of sudden painless visual loss after strenuous physical exercise, coughing, nose blowing, vomiting, or straining during bowel movements.

The pretreatment visual acuity ranged from hand movements to counting fingers. Visual acuity improved in all patients within 24 h following the laser treatment. Although visual acuity levels were lower than 20/20 in most of the patients because of the dispersed vitreous

Table 1 Demographic data and clinical characteristics of the patients

Patient no	Age	Gender	Duration (days)	Size (DD)	VA at presentation	VA after laser treatment						
						24Hr	1Wk	1Mo	3Mo	6Mo	12Mo	24Mo
1	34	F	2	6	HM	20/40	20/20	20/20	20/20	20/20	20/20	20/20
2	24	M	5	9	HM	20/80	20/25	20/20	20/20	20/20	20/20	20/20
3	21	M	4	8	HM	20/32	20/20	20/20	20/20	20/20	20/20	20/20
4	22	M	3	6	CF	20/40	20/20	20/20	20/20	20/20	20/20	20/20
5	53	F	1	7	HM	20/40	20/20	20/20	20/20	20/20	20/20	20/20
6	31	M	4	6	CF	20/32	20/20	20/20	20/20	20/20	20/20	20/20
7	44	F	4	10	HM	20/80	20/25	20/20	20/20	20/20	20/20	20/20
8	29	M	2	8	CF	20/25	20/20	20/20	20/20	20/20	20/20	20/20
9	24	F	1	6	CF	20/25	20/20	20/20	20/20	20/20	20/20	20/20
10	23	M	3	7	HM	20/32	20/20	20/20	20/20	20/20	20/20	20/20
11	35	M	3	5	CF	20/32	20/20	20/20	20/20	20/20	20/20	20/20
12	25	M	5	4	CF	20/32	20/20	20/20	20/20	20/20	20/20	20/20
13	20	M	7	4	CF	20/32	20/20	20/20	20/20	20/20	20/20	20/20
14	21	M	15	5	CF	20/25	20/20	20/20	20/20	20/20	20/20	20/20
15	23	M	18	5	CF	20/25	20/20	20/20	20/20	20/20	20/20	20/20
16	21	M	16	5	CF	20/32	20/20	20/20	20/20	20/20	20/20	20/20

VA: visual acuity; DD: disc diameter; HM: hand movements; CF: counting fingers; F: female; M: male; Hr: hour; Wk: week; Mo: month.

haemorrhage on the first day of follow-up (Figure 1b), all of them improved to 20/20 level at the end of the first week (Figure 1d) except two patients with 9 and 10 DD pretreatment lesions in which vitreous haemorrhage took longer time to resolve than the others. Dispersed vitreous haemorrhage resolved completely within a month in all of the laser treated eyes and no case required vitrectomy. Visual acuity improved to 20/20 level in the first month in all 16 patients and remained the same throughout the 2-year follow-up (Table 1). No vascular or chorioretinal injury induced by Nd:YAG laser was observed and no complications such as macular hole, epiretinal membrane, or tractional retinal detachment occurred in any of the eyes during the follow-up period.

Discussion

Preretinal haemorrhages secondary to Valsalva retinopathy usually resolve by themselves in a few weeks to several months.^{2,3} If observation is chosen as a conservative medical treatment for the patient, the patient should be instructed to avoid strenuous activities to prevent a re-bleed and instructed to sleep in a sitting position to promote blood settling, which may improve visual acuity. However, a quick recovery is desired by most of the patients belonging to a younger age group. This is particularly important for patients with poor vision in their fellow eye and patients requiring rapid visual rehabilitation in order to be able to continue working.

A slowly resolving subhyaloid haemorrhage also prolongs the contact of the retina with haemoglobin

and iron, possibly causing toxic damage to the retina and reducing visual function, which may be irreversible.²²⁻²⁴

Drainage of a premacular subhyaloid haemorrhage and subinternal limiting membrane (ILM) haemorrhage with Nd:YAG laser was described in the late 1980s.^{12,13} The relative distance between the posterior hyaloid face and the retina owing to the convexity of the anterior surface of the subhyaloid haemorrhages has encouraged several investigators for drainage of the entrapped blood into the vitreous via focal posterior hyaloidotomy or membranotomy. This method is used for premacular subhyaloid haemorrhages owing to Valsalva retinopathy, proliferative diabetic retinopathy, retinal artery macroaneurysm, branch retinal vein occlusion, Terson syndrome, and blood dyscrasias.¹²⁻²¹ The power setting of the Nd:YAG laser systems used varied between 2, 1, and 50 mJ.^{13,16} Visual acuity improved within days in most of the patients after treatment and no laser related complications were seen during the follow-up period of 6 months.^{12-15,25} The degree of improvement of the treated eyes depended on the underlying and pre-existing macular damage.

The long-term results of Nd:YAG laser were also studied. Ulbig *et al*²¹ studied 21 eyes with premacular subhyaloid haemorrhage of various causes drained with a pulsed Nd:YAG laser and followed them up between 12 and 32 months. Visual acuity improved in 16 eyes within 1 month. Seven of the patients required vitrectomy. The degree of visual improvement of the treated eyes depended on the underlying cause and the pre-existing macular pathology. Although the eyes with Valsalva retinopathy fared the best and visual acuity improved to 20/20 level in six of seven patients,

a macular hole was identified after the laser treatment in one patient with a 1 DD pretreatment lesion. In another patient a clotted haemorrhage of 35 days' duration persisted despite an opening at the vitreoretinal interface. In conclusion, the authors advocated laser treatment only if the size of the haemorrhage is beyond 3 DD and using energy levels below 9 mJ for safety reasons.²¹

The minimum size of haemorrhage in our study was 4 DDs. Although we examined three patients with 1 DD of premacular subhyaloid haemorrhage, we decided to observe instead of Nd:YAG laser treatment because of the close proximity of the posterior hyaloid face to the retinal surface. Visual acuity improved to 20/20 level gradually in all three patients within three to 6 months without any vitreoretinal complications.

The power required to make a visible puncture on the surface of the subhyaloid haemorrhage varied from 2.2 up to 9.7 mJ in our study. Laser was operated in the Q-switch mode and single bursts were emitted. Although single Q-switched pulse was sufficient to drain the haemorrhage in most of the cases, multiple consecutive applications were needed in a few patients.

We observed that the pupil size is an important parameter that may influence the power setting. Nd:YAG laser is an instrument designed especially for the anterior segment use. Aiming and focusing accuracy of the laser is dependent on the convergence angle. If the pupil is not dilated sufficiently or the laser beam is not aimed through the centre of the pupil, the incident light will fall on the iris and this attenuation of the laser beam will reduce the power density on the desired target. This attenuation may cause the surgeon to increase the power to such a level that if the beam is moved, there could be a photomechanical retinal injury.

The exact localization of the premacular haemorrhage is still unclear. It is believed that the premacular bursa provides a pre-existing anatomic space for this kind of haemorrhage.^{25,26} It is not possible to determine the location of the premacular haemorrhage biomicroscopically but glistening light reflex and fine striae on the surface of the haemorrhage upon fundoscopic examination may indicate involvement of ILM in cases with Valsalva retinopathy.^{2,13} Shukla *et al*²⁷ reported the optical coherence tomography (OCT) scan results of two patients with Valsalva retinopathy and the OCT demonstrated two distinct membranes: a highly reflective band immediately above the premacular haemorrhage corresponding to the ILM and an overlying patchy membrane with low optical reflectivity consistent with posterior hyaloid. Meyer *et al*²⁸ reported a persistent premacular cavity after argon laser membranotomy in a patient with Valsalva retinopathy which was evident by the OCT. During pars plana vitrectomy, the prominent

membrane had no contact with the retinal surface and it was not possible to stain the retinal surface with indocyanine green in the area of the removed sheen-like membrane. They hypothesized that after the submembranous blood was released, the proliferating cells on the ILM and the retinal surface sealed the membranotomy, and the resulting convex cavity persisted. We have not observed any kind of persistent premacular cavity reducing the visual acuity in any of our patients. This difference may be explained with the photodisruptive effect of Nd:YAG which possibly opens a larger window, and this window may not be sealed with the proliferating cells on the ILM.

Kwok *et al*²⁹ reported the histologic findings of a case with Valsalva retinopathy operated for epiretinal membrane formation 10 months after Nd:YAG laser membranotomy. Histologic examination revealed the presence of hemosiderin within the retinal side of ILM. One year after surgery, the patients' visual acuity was 20/20 without any retinal damage. Nd:YAG membranotomy was performed with a single 4.0 mJ Q-switched pulse targeting on the membrane and caused an immediate drainage of the haemorrhage into the vitreous cavity. Although we used higher energy levels in some of our patients, we did not observe epiretinal membrane formation and none of our patients developed metamorphopsia during a 2-year follow-up period.

The timing of Nd:YAG laser procedure is another important issue. Cheung *et al*³⁰ reported a case of bilateral premacular subhyaloid haemorrhage as a result of chemotherapy-induced pancytopenia. Nd:YAG laser membranotomy was performed in the right eye in 3 weeks after the initial symptoms. Although the ILM was visibly punctured, no dispersion of blood was seen and after a 1-week follow-up there was no change in the visual acuity. Similarly, Ulbig *et al*²¹ reported one patient with clotted premacular haemorrhage of 35 days old owing to BRVO in which drainage of blood into vitreous failed despite two visible punctures at the surface of the haemorrhage. In our series, there were three cases with a duration of haemorrhage longer than 2 weeks. Although there was an immediate stream of red blood cells into the vitreous following the laser treatment in cases with less than 1 week of duration, there was little change immediately after the treatment in cases with more than 2 weeks of duration and the drainage of the haemorrhage was slower but their visual acuity improved to 20/20 level at the end of the first week.

In accordance with the other studies, the improvement in the visual acuity in the patients with Valsalva retinopathy was prompt and fast in our study group. When it is considered that these patients are young, otherwise healthy and they belong to the working population for whom rapid restoration of visual acuity

is important, Nd:YAG laser treatment in this condition hastens the visual recovery but needs to be balanced against the theoretical risk of damage to the retina and seems to be safe and effective in a selected group of patients with Valsalva retinopathy. Patients with a premacular subhyaloid haemorrhage larger than 3 DD with no longer than 3 weeks duration may be considered as candidates for Nd:YAG laser treatment and should be informed about the benefits and risks of the treatment. In summary, for a safe and successful result, it is important; (1) to work with the widest pupil diameter, (2) to keep the laser beam aimed through the centre of the pupil, and (3) to focus the aiming beam precisely on the surface of the premacular subhyaloid haemorrhage at a location close to the inferior edge but distant from the fovea and the retinal blood vessels with a sufficient thickness of blood to protect the underlying retina, and (4) to start the treatment with the lowest possible energy level and then gradually increase the energy level until perforation becomes visible on the surface of the haemorrhage.

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