Long-term Results After Drainage of Premacular Subhyaloid Hemorrhage Into the Vitreous With a Pulsed Nd:YAG Laser

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Objective: To investigate the effects of drainage of premacular subhyaloid hemorrhage into the vitreous with an Nd:YAG laser in a large series of patients with long-term follow-up.

Methods: A retrospective review was conducted on 21 eyes with a circumscribed premacular subhyaloid hemorrhage of various causes. These eyes were treated with a pulsed Nd:YAG laser to drain the entrapped blood into the vitreous. The period of review ranged from 12 to 32 months (mean, 22 months).

Results: In 16 eyes, visual acuity improved within 1 month. Four eyes had persistent, dense, nonclearing vitreous opacity for at least 3 months and finally required vitrectomy. One clotted hemorrhage did not drain into the vitreous. Final visual outcome was determined by the underlying diagnosis, such as Valsalva retinopathy (7 eyes), diabetic retinopathy (7 eyes), branch retinal vein occlusion (4 eyes), and retinal macroaneurysm, Terson syndrome, or blood dyscrasia (1 eye each). Eyes with Valsalva retinopathy fared the best. Complications included a macular hole in 1 eye and a retinal detachment from a retinal break in a myopic patient.

Conclusions: Drainage of premacular subhyaloid hemorrhage into the vitreous with an Nd:YAG laser is a viable treatment alternative for eyes with recent bleeding. However, a macular hole and a retinal detachment were observed as complications. Thus, to establish Nd:YAG laser treatment as a routine procedure, the risks and benefits have to be weighed in a randomized trial and compared with those of deferral of treatment or primary vitrectomy.


VARIOUS VASCULAR or hematologic disorders can cause circumscribed premacular hemorrhage at the vitreoretinal interface, leading to a sudden loss of vision.1-8 Spontaneous resorption of the blood entrapped in the subhyaloid space tends to be slow and may result in long-standing visual impairment.5-10 A small premacular hemorrhage of 1 disc diameter caused by Valsalva retinopathy has been reported to resolve within several months,7 whereas a dense preretinal hemorrhage resulting from diabetic retinopathy persisted for more than 1 year. In longstanding cases, the formation of an epiretinal membrane has been observed, and early pars plana vitrectomy has been recommended.8 Macular traction also has been reported after resorption of a preretinal hemorrhage derived from a retinal macroaneurysm.6

Puncturing the posterior hyaloid face or internal limiting membrane by means of a pulsed Nd:YAG laser has been described as a viable alternative to vitrectomy as management for extensive premacular subhyaloid hemorrhage.1,5,6,11-14 This method enables drainage of entrapped premacular subhyaloid blood into the vitreous. Hence, the obstructed macular area is cleared and absorption of blood cells may be facilitated. In previous studies,1,5,6,11-14 restoration of central vision within days was reported. In cases with underlying ischemic, edematous, or vascular abnormality, macular laser photocoagulation was expedited.12,13 Complications related to the Nd:YAG laser have not been described as yet, but previous reports are limited to a small number of selected cases and a short period of follow-up. Our series of cases was evaluated to further investigate the effects of Nd:YAG laser drainage of premacular subhyaloid hemorrhage into the vitreous in a larger series with longer follow-up.

RESULTS

In this series, visual improvement was defined as an increase of 3 lines or more on a decimal visual acuity chart. Success of
PATIENTS AND METHODS

This is a retrospective study of 21 patients who each had a circumscripted premacular subhyaloid hemorrhage in 1 eye and who were treated with the Nd:YAG laser to drain the entrapped blood into the vitreous. Sixteen patients were treated at the University Eye Hospital, Munich, Germany, and 5 patients at Moorfields Eye Hospital, London, England. The laser procedures were performed between October 1, 1993, and March 31, 1995. Ten patients were female and 11, male. Ages ranged from 10 to 77 years. The period of follow-up was 12 to 32 months (mean, 22 months). Valsalva retinopathy (7 eyes), diabetic retinopathy (7 eyes), branch retinal vein occlusion (4 eyes), retinal macular edema (1 eye), Terson syndrome (1 eye), and blood dyscrasia (1 eye) were diagnosed (Table). All patients provided informed consent before treatment.

The time elapsed between onset of hemorrhage and laser treatment was recorded. Pretreatment and posttreatment examinations included stereoscopic biomicroscopy of the posterior pole and peripheral retina, best-corrected visual acuity, and color fundus photographs. The horizontal and vertical diameter of the preretinal hemorrhage was measured in disc diameters by layover with transparencies for either 30° or 50° fundus photographs in a standardized manner. Finally, the vertical and horizontal measurements were averaged (Table). Fluorescein angiography or fundus imaging with a laser scanning ophthalmoscope was performed in selected patients.

All laser treatments were done with the patient under topical anesthesia with the use of benoxinate hydrochloride eyedrops. Tropicamide eyedrops were applied to dilate the pupil. An Nd:YAG laser (LASAG Microruptor II, LASAG, Thun, Switzerland) was used, and a wavelength of 1064 nm was emitted via a slitlamp microscope (Zeiss, Oberkochem, Germany) and a contact lens (LASAG GGV [contact glass vitreous], LASAG). The laser was always operated in the Q-switched fundamental mode (10 nanoseconds) and single bursts were emitted. Laser exposures were started with low energies of 2 mJ and then gradually increased until perforation became visible at the surface of the hemorrhage. The maximum energy applied was 9 mJ. The puncture was performed in the lower and most prominent area of the hemorrhage to protect the foveola from the laser impact and to support outflow by gravity (Figure 1). In hemorrrhages larger than 3 disc diameters, 2 punctures were made in proximity. All laser settings were recorded. Patients were followed up at 2 weeks, 1 month, and 3 months postoperatively and twice a year thereafter. Patients who did not attend follow-up examinations on a regular basis or had a follow-up of less than 12 months were excluded from the analysis.

In eyes with proliferative diabetic retinopathy and no clinical signs or history of macular edema, panretinal photocoagulation was performed with approximately 1000 laser exposures before Nd:YAG laser treatment. This was done in case blood dispersed in the vitreous and did not clear within 3 months, and thus precluded an urgently required panretinal photocoagulation.

The laser procedure was defined as visual improvement within 1 month and no further need to clear the vitreous using surgery.

By this definition, drainage of premacular subhyaloid hemorrhage into the vitreous with the Nd:YAG laser succeeded in 16 of 21 eyes treated (Table, patients 1, 3, 4, 6-15, 18, and 21). Nineteen patients, including an additional vitrectomy, enjoyed visual improvement of the treated eye at the last follow-up examination after a mean period of 22 months. This total includes patients 2, 19, and 20. In the remaining 2 eyes, visual acuity remained poor because of a subsequent retinal detachment involving the macula or persistent diffuse diabetic macular edema (patients 9 and 17). Overall, visual improvement was best in eyes with Valsalva retinopathy and Terson syndrome. These eyes all improved, including 1 eye with a small Valsalva-related premacular subhyaloid hemorrhage of only 1 disc diameter and a macular hole after laser drainage of the entrapped blood into the vitreous (patient 10). Macular hole surgery reattached the edges and visual acuity remained stable at 20/33 thereafter (Figure 2). Eyes with diabetic retinopathy or branch retinal vein occlusion also regained vision, except for patient 17, but visual recovery was usually compromised by the retinal or macular disease.

In eyes successfully treated by laser, outflow of blood through the opening at the anterior surface of the hemorrhage into the vitreous was biomicroscopically visible, and visual acuity improved because of removal of the premacular subhyaloid hemorrhage. Some remnants of blood were still visible in the dependent part of the vitreous cavity. Patient 15 also had limited central vitreous haze after 1 month, but this finally cleared completely and spontaneously, and visual acuity improved further.

Drainage of blood into the vitreous failed in patient 2, who experienced a clotted premacular hemorrhage of 35 days’ duration despite 2 visible punctures at the surface of the hemorrhage. Four patients (patients 2, 5, 17, and 20) had dense, nonclearing vitreous opacity for at least 3 months after laser drainage of the entrapped blood into the vitreous, precluding visual improvement and finally requiring vitrectomy.

Overall, 7 eyes finally required an additional vitrectomy because of persistence of dispersed blood in the center of the vitreous gel (patients 5, 17, 19, and 20), a clotted hemorrhage that refused to drain into the vitreous despite an opening to the vitreous (patient 2), a macular hole (patient 10), and a retinal redetachment (patient 9). In two thirds of study eyes, the laser procedure was successful in preventing vitrectomy surgery.

COMMENT

The application of the Q-switched Nd:YAG laser for drainage of a premacular subhyaloid hemorrhage into the vitreous was first described by Faulborn et al in 1988 for an eye with diabetic retinopathy. One year later, Gabel and coworkers treated 3 eyes with subinternal limiting membrane hemorrhage of various causes by the same technique. Drainage of entrapped blood into the vitreous was...
achieved via a single perforation at the anterior face of the hematoma with the use of energies ranging from 3.6 to 50 mJ. Visual acuity improved within days after treatment, and there were no complications during a 6-month period of follow-up.

Other reports on a total of 7 eyes treated by laser with the same technique also revealed rapid clearing of subhyaloid blood and satisfactory visual outcome.\textsuperscript{1,11,13} The power settings of the Nd:YAG laser systems used varied between 2.5 and 10.5 mJ. During the overall follow-up period of 6 months, no laser-induced complications were noted. Raymond\textsuperscript{12} reported on 6 cases with a premacular hemorrhage, originating from proliferative diabetic retinopathy in 4 eyes and from a retinal macroaneurysm in 2 eyes, treated with laser energies up to 11.5 mJ.\textsuperscript{12} During a mean follow-up period of 20 months, 4 eyes showed a gradual improvement of visual acuity. 1 eye had little visual improvement because of preexisting subretinal hemorrhage, and 1 diabetic eye required vitrectomy because of persistent vitreous hemorrhage. No retinal or choroidal injury related to Nd:YAG laser treatment was identified in the latter series.

In our series, drainage of premacular subhyaloid hemorrhage into the vitreous with an Nd:YAG laser was performed in 21 eyes with hemorrhage of various severity and causes. Results confirm that a recent premacular subhyaloid hemorrhage can be drained into the vitreous with Nd:YAG laser treatment.

Good visualization of the macular region of the retina was rapidly restored within 1 month in most cases. This is in accordance with the results of Raymond\textsuperscript{12} and Ezra et al.\textsuperscript{13} However, a total of 7 eyes finally required an additional vitrectomy because of persistence of dispersed blood in the central vitreous, a clotted hemorrhage that refused to drain into the vitreous despite an opening at the vitreoretinal interface, a macular hole, and a retinal detachment. Thus, in one third of the eyes, the laser procedure failed to prevent vitrectomy in the long term. The pretreatment duration of hemorrhage seems to be of prognostic importance. We could not drain clotted premacular subhyaloid hemorrhage of 35 days’ duration into the vitreous. This is in accordance with a report by Mansour.\textsuperscript{16} Usually, soon after bleeding, a fluid level resulting from the settling of cellular components of the blood gives the characteristic boat-shaped appearance. With time, the hemorrhage turns yellowish because of degeneration of hemoglobin, and then this clotted blood is unlikely to drain into the vitreous gel despite successful perforation.

Visual improvement after Nd:YAG laser treatment resulted within 1 month in 16 of 21 eyes treated. The degree of visual improvement of treated eyes depended on the underlying diagnosis and preexisting macular damage. Seven eyes with a hemorrhage resulting from a Valsalva maneuver (6 eyes) or Terson syndrome (1 eye) fared best.

\[\text{Patient No.} / \text{Sex/ age, y} \quad \text{Diagnosis} \quad \text{Size of Hemorrhage, Disc Diameter} \quad \text{Duration of Hemorrhage, d} \quad \text{Before Treatment} \quad \text{After 1 mo} \quad \text{Last Review} \quad \text{Remarks}
\]

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<th>Patient No.</th>
<th>Sex/ age, y</th>
<th>Diagnosis</th>
<th>Size of Hemorrhage, Disc Diameter</th>
<th>Duration of Hemorrhage, d</th>
<th>Before Treatment</th>
<th>After 1 mo</th>
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<tr>
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<td>HM CF 20/50 (17)</td>
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*BRVO indicates branch retinal vein occlusion; PDR, proliferative diabetic retinopathy; HM, hand motion; CF, counting fingers; and NPDR, nonproliferative diabetic retinopathy.
In premacular subhyaloid hemorrhage with underlying retinal disease such as diabetic neovascularization or macular edema, there is not only short-term visual benefit from the Nd:YAG laser treatment, but also improved retinal visualization and expedited access for focal photocoagulation. By contrast, dispersion of the formerly entrapped blood into the vitreous gel may be a disadvantage and prevent panretinal photocoagulation, ie, in cases with proliferative diabetic retinopathy, especially if the resulting vitreous haze is persistent for months. Therefore, in eyes with proliferative diabetic retinopathy and no clinical signs or history of macular edema, we performed panretinal laser photocoagulation first and punctured the premacular subhyaloid hemorrhage as a secondary procedure.

There is a controversy on the effects of preretinal blood on the retina itself, as epiretinal membrane formation may be induced and a toxic effect of dissolving hemoglobin has been suggested after long-standing contact between blood and retina.

Furthermore, it is unclear which anatomic layer covering a premacular subhyaloid hemorrhage is targeted with the Nd:YAG laser puncture. It is generally agreed that premacular hemorrhages are located at the vitreoretinal interface. The most common site is at the posterior pole, where the premacular bursa provides a preexisting anatomic barrier against vitreous penetration. However, the exact location of the hemorrhage may vary.

Figure 1. Patient 6. A, An extended premacular subhyaloid hemorrhage. B, After puncture with the Nd:YAG laser, outflow of entrapped blood is visible. C, After 1 hour, the macula is almost free of blood.

Figure 2. Patient 10. A, A small, round premacular subhyaloid hemorrhage. B, After Nd:YAG laser drainage, there is a macular hole with elevated retinal margins.
tomic space for this kind of hemorrhage.14,18 The presence of a glistening light reflex and fine striae on the surface of the hemorrhage upon funduscopic examination may indicate involvement of the internal limiting membrane. It is believed that in cases with Terson syndrome and Valsalva retinopathy, the premacular hemorrhage occurs beneath the internal limiting membrane.6,7,19 From our clinical observation, the exact location of the premacular subhyaloid hemorrhage is impossible to determine biomicroscopically. Therefore, we refused to use terms specifying anatomical layers, such as “photodisruption of the hemorrhagic detachment of the internal limiting membrane” or “posterior hyaloidotomy.”1,6,11,12,14,15

In our series, a retinal detachment occurred as a complication in 1 patient with bilateral myopia and associated retinal breaks, but retinal breaks occurred in his untreated fellow eye as well. Peripheral retinal breaks and retinal detachment are also a well-recognized complication of Nd:YAG laser capsulotomy after cataract surgery.20-22 The macular hole identified after Nd:YAG laser treatment in a young woman with Valsalva retinopathy was another complication. Possibly the photodisruptive effect was too close to the macula. The entrapped blood is believed to act as a cushion, dampening the disruptive impact of the Nd:YAG laser burst, as indicated by visible fluid waves. In a small hemorrhage, the laser burst occurs close to the macula, and the protective dampening effect may be insufficient. Although a macular hole was observed neither in the other eyes with more extended hemorrhages that were treated nor in eyes treated by other authors,1,5,6,11-16 this serious complication clearly limits the safety of the procedure. This may be important for small premacular subhyaloid hemorrhage, which is considered self-limiting.7 Therefore, from our experience, we advocate laser drainage only if the size of the hemorrhage is beyond 3 disc diameters. Precise focusing of the surface of the hemorrhage seems to be important, too, and we do not exceed energies of 9 mJ for safety reasons.20

In conclusion, Nd:YAG laser treatment may be considered for recent premacular subhyaloid hemorrhage beyond 3 disc diameters in diameter. Clinical benefits include rapid visual rehabilitation, visualization of the underlying retina, expedited access for macular photocoagulation, and the avoidance of vitrectomy in two thirds of cases. Further long-term surveillance of laser-treated cases is necessary, and only randomization with deferral of treatment or vitrectomy can define benefits and disadvantages.

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REFERENCES


Correction

In the article titled “Early Worsening of Diabetic Retinopathy in the Diabetes Control and Complications Trial,” published in the July 1998 issue of the ARCHIVES (1998;116:874-886), an error appeared in Figure 4 on page 884. The key explaining the solid and dashed lines should not have appeared in the figure. The solid and dashed lines are correctly defined in the figure legend. The journal regrets the error.