Photodisruptive Nd:YAG laser in the management of premacular subhyaloid hemorrhage

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PURPOSE. *Premacular subhyaloid hemorrhage is usually a benign condition that generally improves spontaneously and rarely causes visual loss. However, because the hemorrhage may cause permanent macular changes before it resolves, Nd:YAG laser posterior hyaloidotomy may be indicated in selected cases. This study investigated the effects of drainage of premacular subhyaloid hemorrhage into the vitreous with Nd:YAG laser treatment.*

METHODS. *This study was conducted between February 1996 and March 1999. Six patients had a circumscribed premacular hemorrhage in one eye and were treated with the Nd:YAG laser to drain the blood into the vitreous cavity. The hemorrhage originated from Valsalva retinopathy (2 cases), proliferative diabetic retinopathy (2 cases), central retinal vein occlusion (1 case), and blunt ocular trauma (1 case). The size of the hemorrhage is expressed in disc diameters.*

RESULTS. *The mean pretreatment hemorrhage measured 5.7 disc diameters (range 3.5-8.0). Visual acuity in all cases before laser treatment was hand movement. After laser treatment, the hemorrhage instantly drained into the vitreous cavity, resulting in rapid improvement of vision. Drainage was complete within one week and visual acuity improved dramatically. The mean follow-up was 26.3 months (range 7-42 months). No retinal damage or rebleeding occurred due to the laser treatment, and vitrectomy was not required in any eye.*

CONCLUSIONS. *Nd:YAG laser posterior hyaloidotomy may be useful for draining a premacular hemorrhage into the vitreous cavity in selected cases. To establish this as a routine procedure, a randomized prospective study is needed to compare observation, primary vitrectomy, and Nd:YAG laser treatment. (Eur J Ophthalmol 2001; 11: 281-6)*

KEY WORDS. *Nd:YAG laser, Premacular subhyaloid hemorrhage, Subinternal limiting membrane hemorrhage, Nd:YAG laser posterior hyaloidotomy*

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INTRODUCTION

Various vascular or hematological disorders can cause circumscribed premacular hemorrhage at the vitreoretinal interface (1-4). Valsalva retinopathy, proliferative diabetic retinopathy, retinal artery macroaneurysm, or trauma can all cause subhyaloid or subinternal limiting membrane hemorrhage in the macula (1,5-7). Subinternal limiting membrane hemorrhages may occur after rupture of a retinal vessel associated with physical exertion and increased venous pressure or in retinal vascular disorders such as proliferative diabetic retinopathy (8-10). These hemorrhages occur between the internal limiting membrane and the rest of the retina (2, 4, 5, 11). However, subhyaloid hemorrhage is anterior to the internal limiting membrane, forming a preretinal hemorrhage (5, 11). It is caused by bleeding from retinal tears and rupture of

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the internal lmiting membrane (11, 12).

All premacular hemorrhages lead to sudden, severe visual loss (3, 11). Premacular hemorrhage in Valsalva retinopathy has been reported to clear within weeks or months, whereas a dense subhyaloid hemorrhage resulting from diabetic retinopathy may last more than a year (1, 13). Premacular subhyaloid hemorrhage may be associated with permanent macular changes before spontaneous resolution (5, 13, 14). In long-standing cases, the formation of epiretinal membrane overlying the macula and tractional macular detachment may develop after a premacular subhyaloid hemorrhage, and pars plana vitrectomy is recommended (13).

Focal opening of the posterior hyaloid face or internal limiting membrane with a pulsed Nd:YAG laser has been described as a viable alternative to vitrectomy to achieve rapid intravitreal drainage of extensive premacular subhyaloid hemorrhage (4, 11). This treatment allows the blood to enter the vitreous cavity leading to prompt visual improvement (3, 4, 11).

The purpose of this study was to assess Nd:YAG laser posterior hyaloidotomy as an alternative for treating premacular subhyaloid hemorrhage.

METHODS

This study was run between February 1996 and March 1999 in the Eye Clinic at Firat Medical Center. Six patients had a circumscribed premacular hemorrhage in one eye. Two were female and four male, aged from 17 to 63 years (mean 39.7 years). Valsalva retinopathy (2 cases), proliferative diabetic retinopathy (2 cases), central retinal vein occlusion (1 case), and blunt eye trauma (1 case) were diagnosed. All the patients provided informed consent before Nd:YAG laser treatment. Premacular subhyaloid hemorrhage was treated with the Nd:YAG laser to drain the trapped blood into the vitreous cavity.

The time between onset of the hemorrhage and Nd:YAG laser treatment was recorded. Pre- and post-treatment ophthalmic examinations included best-corrected visual acuity, stereoscopic biomicroscopy of the retina, color fundus photographs, and fundus fluorescein angiography. The size of the hemorrhage was expressed in disc diameters. Complete blood count, platelet count and hemoglobin analysis were all done.

The pupil was dilated maximally with 1% tropicamide and 10% phenylephrine before treatment. All laser procedures were done with the patient under topical anesthesia with benoxinate hydrochloride eyedrops. The procedure was performed with a Q-switched YAG laser (Zeiss, Visulas YAG FL, Germany) and a 25-mm Peyman YAG contact lens. An opening was made with the laser in the lower and most prominent area of the subhyaloid hemorrhage to protect the foveola from the laser's impact, allowing a rapid stream of trapped blood to flow into the vitreous cavity (Figs. 1a, 1b and 2). Sometimes a second puncture was made over the hemorrhage when little blood entered the vitreous cavity from the first opening. Where perforation was effective the hemorrhage could be seen draining into the vitreous cavity immediately.

In each case, te least possible energy per plasma, and the minimum number of plasmas were used. A plasma energy of 7.3 mJ was used initially and increased in 0.2 to 0.5 mJ steps until effective perforation could be achieved. The total number of laser bursts was recorded. All patients were re-examined 1 hour after treatment to ensure that the hemorrhage was still dispersing into the vitreous.

After the laser treatment, a full assessment of the macula and retina was possible in all eyes, including fundus fluorescein angiography, within three weeks. Patients were followed up at 1 week, 1 month, 3 months, and 6 months postoperatively. Two cases with proliferative diabetic retinopathy had undergone previous panretinal photocoagulation before Nd:YAG laser treatment. One patient with central retinal vein occlusion underwent panretinal photocoagulation two months after this laser treatment (Figs. 1a, 1b, and 2).

RESULTS

The mean interval between the onset of the subhyaloid hemorrhage and clinical examination was 2.2 days (range 1.0 to 4.0 days). The size of the hemorrhage ranged from 3.5 to 8.0 disc diameters (mean 5.7). The mean total laser power required for posterior hyaloidotomy was 13.9 mJ (range 7.3 to 27.0 mJ). Individual plasma energies varied from 7.3 to 9.0 mJ (mean 8.1 mJ). Perforation of the posterior hyaloid membrane was complete in all eyes in a single procedure but one eye required further membranotomy (case 4). Drainage of the hemorrhage

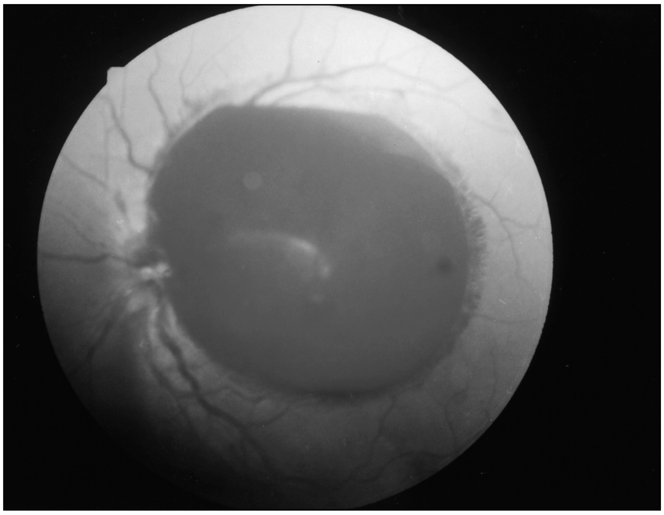

Fig. 1a - *Appearance of the fundus before laser treatment, showing subhyaloid hemorrhage covering the posterior pole in the left eye of case 1.*

Fig. 1b - *Appearance of the posterior pole one month after Nd:YAG laser posterior hyaloidotomy: visual acuity is 20/20 in the left eye of the same patient.*

into the vitreous was complete in all cases within one week. The hemorrhage in the vitreous resolved completely one month later. The mean follow-up was 26.3 months (range 7-42 months). No retinal damage or rebleeding occurred due to the laser treatment, and vitrectomy was not required in any eye.

In successfully treated eyes the flow of blood into the vitreous through the opening on the anterior surface of the premacular subhyaloid hemorrhage was biomicroscopically visible, and visual acuity improved as the blood was removed. Visual acuity was hand movement in all patients before laser treatment. During the first week after treatment, visual acuity improved dramatically. One, three and six months after treatment, visual acuities ranged respectively from 20/20 to 20/400 (mean 20/160), 20/20 to 20/200 (mean 20/77), and 20/20 to 20/200 (mean 20/62). Overall, visual improvement was best in eyes with Valsalva retinopathy and blunt eye trauma. Eyes with proliferative diabetic retinopathy or central retinal vein occlusion also regained vision, but recovery was usually limited by the macular or retinal disease.

One eye with proliferative diabetic retinopathy had neovascularization and argon laser photocoagulation was done. The other cases had no evident new vessels or macular edema after posterior hyaloidotomy and needed no further treatment. Nd:YAG laser-induced chorioretinal injuries were excluded by fundus fluorescein angiography and no iatrogenic complications arose. The clinical features and treatment results of the patients are summarized in Table I.

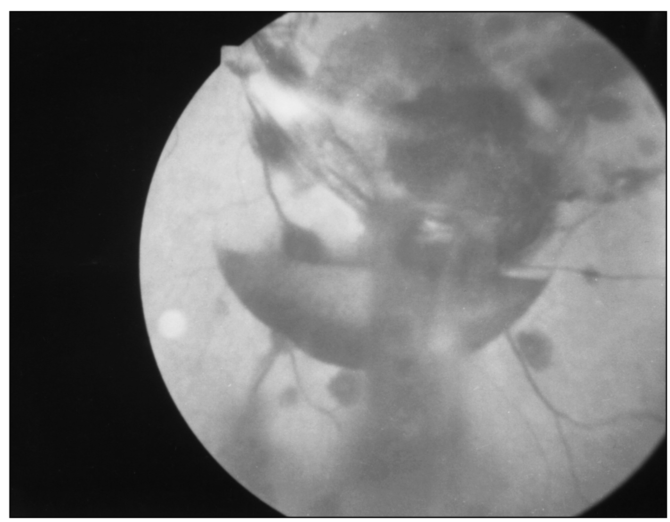

Fig. 2 - *Immediately after Nd:YAG laser posterior hyaloidotomy, a stream of blood flowed into the vitreous cavity in the left eye of case 4.*

DISCUSSION

Subhyaloid hemorrhage or subinternal limiting membrane hemorrhage in the macula may occur after rupture of a retinal vessel with physical exertion

(Valsalva retinopathy) or in retinal vascular diseases, such as proliferative diabetic retinopathy, and retinal macroaneurysm (2, 4-7, 11). It is generally agreed that premacular hemorrhages are located at the vitreoretinal interface (4). From our clinical observation it is impossible to establish the exact location of premacular hemorrhage biomicroscopically. In patients with subhyaloid premacular hemorrhage, visual acuity is often severely reduced (2, 4, 5). The hemorrhage usually clears spontaneously, but it may take several months (5, 11, 13). There is controversy on the effects of preretinal blood on the retina itself, as epiretinal membrane may be induced and a toxic effect of dissolving hemoglobin has been suggested after long contact between blood and retina (4, 5, 13). In other words, spontaneous resolution of a subhyaloid hemorrhage may leave the eye with permanent macular changes (5, 13).

Nd:YAG laser treatment is commonly used for various anterior segment procedures (2, 11, 15). Posterior segment applications of the Nd:YAG laser have generally been limited to transection of vitreous membranes away from the retina (16, 17). The Q-switched Nd:YAG laser has been used to drain a premacular subhyaloid hemorrhage into the vitreous cavity (2, 3, 5, 6). Nd:YAG laser posterior hyaloidotomy provides an additional option that may be valuable in some situations. It can speed the recovery of visual acuity in selected patients; it may be indicated in cases of persistent or slowly clearing subhyaloid hemorrhage; it can shorten the waiting time and quickly restore binocular vision.

Rupturing the posterior hyaloid requires accurate focusing over the anterior surface of the hemorrhage; otherwise optical breakdown will not occur, since the irradiance needed to start plasma formation cannot be achieved (5). We treated the inferior aspect of the hemorrhagic detachment cavity away from the fovea. This technique may be difficult in eyes with less extensive hemorrhage than our patients. Serious complications such as hemorrhage, retinal holes and macular injuries can result from Nd:YAG laser application of the posterior segment (4, 18) and these may be important for small premacular subhyaloid hemorrhage, which is considered self-limiting (1, 4). Therefore, Ulbig et al advocate laser drainage only if the hemorrhage is bigger than three disc diameters (4). The mean size of the premacular subhyaloid hemorrhages here was 5.7 disc diameters and no retinal injury was observed in any of our cases.

Precise focusing of the surface of the hemorrhage is important too, and Jampol et al do not exceed energies of 9 mJ for safety reasons (19). But no complications were reported due to Nd:YAG laser posterior hyaloidotomy, even with 50 mJ (2). Still, it is always advisable to keep in mind that posterior segment Nd:YAG laser applications can cause sight-threatening complications. Boldrey et al suggested that many asymptomatic laser injuries outside the foveal area are not documented because they are asymptomatic (20). Disruption of retinal tissue and associated hemorrhage can result in retinal fibroglial formation and macular pucker or preretinal fibrovascular prolifera-

TABLE I – MAIN CLINICAL FEATURES OF PATIENTS WITH PREMACULAR SUBHYALOID HEMORRHAGE

Case no.	Sex Age (yr)	Diagnosis	Size of hemorrhage DD	Duration of hemorrhage d	Pre-laser VA	Post-laser VA (months) 1.	3.	6.	Energy mJ
1	M, 19	VR	8.0	3	HM	20/20	20/20	20/20	2 x 8.3
2	M, 63	PDR	5.0	2	HM	20/400	20/200	20/200	2 x 7.6
3	F, 27	VR	6.0	1	HM	20/20	20/20	20/20	1 x 7.3
4	F, 52	CRVO	6.0	4	HM	20/100	20/100	20/40	2 x 7.4
									Plus 1 x 8.4
5	M, 60	PDR	3.5	2	HM	20/400	20/100	20/70	3 x 9.0
6	M, 17	BET	5.5	1	HM	20/20	20/20	20/20	1 x 7.9

DD: disc diameter, VA: visual acuity, VR: Valsalva retinopathy, PDR: proliferative diabetic retinopathy, CRVO: central retinal vein occlusion, BET: blunt eye trauma, HM: hand motion

tion in some patients after ocular laser injury (21). However, none of our patients developed visually significant macular pucker or other complications.

Gabel et al treated three eyes with subinternal limiting membrane hemorrhage of various causes by Nd:YAG laser (2). Drainage of subinternal lmiting membrane hemorrhage into the vitreous was achieved through a single perforation at the face of the hemorrhage, with energies ranging from 3.6 to 50 mJ (2). Visual acuity improved within days and there were no complications. Other reports on patients treated by ND:YAG laser with the same technique indicated rapid clearing of premacular subhyaloid hemorrhage and satisfactory visual outcome (3, 5). Raymond reported six cases with premacular hemorrhage, originating from proliferaitve diabetic retinopathy and from a retinal macroaneurysm, treated with laser energies up to 11.5 mJ (11).

A comprehensive study was done by Ulbig et al (4). Twenty-one patients with premacular hemorrhage caused by different factors were treated by Nd:YAG laser posterior hyaloidotomy, using energies from 2.0 to 9.0 mJ. No retinal or choroidal injury related to the laser treatment was identified (3-5, 11). The laser energy levels we used were very similar those used in previous reports (ranging 7.3 to 9.0 mJ) and no complication has been seen during the follow-up.

In all cases, drainage of the hemorrhage into the vitreous resulted in a dramatic increase in visual acuity, which continued improving for one week. The degree of improvement dependend on the underlying diagnosis and preexisting macular disease. Three eyes with a hemorrhage resulting from Valsalva retinopathy or blunt eye trauma fared best. This is in accordance with the results of the other series (2, 4, 5, 11, 22).

Raymond, and Ulbig and coworkers' rationale for performing Nd:YAG laser posterior hyaloidotomy in their diabetic cases was that waiting for spontaneous resolution could increase the risk of proliferative diabetic retinopathy (4, 11). A special approach may be needed in cases with proliferative diabetic retinopathy and subhyaloid hemorrhage. Panretinal photocagulation, or at least partial treatment around the hemorrhage before Nd:YAG laser posterior hyaloidotomy, may reduce the risk of a new hemorrhage (4, 5, 11). We therefore did retinal photocoagulation first and then attempted to resolve the subhyaloid hemorrhage by Nd:YAG laser in patients with proliferative diabetic retinopathy. During the follow-up, no case required additional vitrectomy procedures.

Another factor that increases the success of Nd:YAG laser posterior hyaloidomy was the duration of premacular hemorrhage. One clotted premacular hemorrhage refused to drain into the vitreous cavity despite an opening at the posterior hyaloid. Ulbig et al also reported they could not drain a clotted hemorrhage of 35 days' duration into the vitreous cavity (4). This situation is in accordance with a report by Mansour (23). We did not meet this difficulty because of the short duration of hemorrhage of our cases. The perforations were successful and the premacular hemorrhages were drained into the vitreous cavity in a week in all our cases.

There is no special lens for Nd:YAG laser posterior hyaloidotomy. The Mainster lens, Goldmann lens and standard retinal laser lenses can all be used (3, 24). We used the 25 mm Peyman YAG lens.

In conclusion, Nd:YAG laser treatment may be considered for selected cases of recent premacular subhyaloid hemorrhage beyond three disc diameters in size. This treatment shortens the time for blood absorption and leads to rapid visual recovery. Further studies appear warranted to evaluate this treatment, particularly with respect to the long-term visual prognosis.

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