Evaluation of the Effectiveness of Nd:Yag Laser Hyaloidotomy Applied to Subhyaloid Hemorrhages Due to Various Etiologies

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ABSTRACT

Purpose: To evaluate the efficacy of Nd:Yag laser hyaloidotomy applied to patients with subhyaloid hemorrhage due to different etiologies.

Method: The study included 14 eyes of 14 patients who underwent Nd:Yag laser hyaloidotomy between January 2022 and January 2024. The patients' age, gender, causes and diameters of subhyaloid hemorrhage, the time from the onset of complaints to laser application, initial best corrected visual acuities (BCVA), 1st week and 1st month BCVAs were recorded. Fundus photographs were taken.

Results: Six of the patients had Valsalva retinopathy, 4 had diabetic retinopathy, 2 had retinal vein occlusion, 1 had choroidal neovascularization, and 1 had retinal macroanesrysma. The mean time between symptom onset and application time was 12.07±10.77 days. Subhyaloid hemorrhage areas had an average optic disc diameter of 7.14±3.27. While Nd:Yag laser hyaloidotomy was successful in 13 of 14 eyes, it was not successful in the patient with the longest application time and the largest bleeding area.

Conclusion: Nd:Yag laser hyaloidotomy is a cheap, effective and safe method used in subhyaloid hemorrhages due to different etiologies. It can be preferred in patients with only one eye or in patients who work in jobs that require rapid visual recovery. Visual recovery is generally good, although it depends on the underlying disease.

Keywords: subhyaloid hemorrhage, valsalva, yag laser

INTRODUCTION

Subhyaloid hemorrhage is the local separation of the vitreous from the retina layer due to accumulation of blood under the hyaloid. When it occurs in the macular area, it is called premacular subhyaloid hemorrhage and it seriously reduces vision (1). The vision loss that develops is usually unilateral and painless (2). The most common cause is Valsalva retinopathy (VR), which develops due to increased intrathoracic pressure. The Valsalva maneuver involves forceful exhalation with the glottis closed. This occurs after a sudden increase in venous blood pressure due to the increase in intrathoracic or intra-abdominal pressure. This is followed by a sudden increase in intraocular venous pressure and a spontaneous rupture of the retinal perifoveal capillaries (3). Other causes are proliferative diabetic retinopathy, retinal macroaneurysm, retinal vein occlusions, age-related macular degeneration and trauma (4). The main cause of subhyaloid hemorrhages due to other diseases is vascular deterioration. Such bleeding may resolve spontaneously within 6-9 months. However, this depends on the extent and cause of bleeding (3). Different methods are available to treat subhyaloid bleeding. The most frequently used of these is observation. Rapid improvement of visual acuity may be required in young,

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active working patients with major bleeding causing profound vision loss to prevent loss of work capacity or to ensure the comfort of life in one-eyed patients (2). In cases requiring treatment, Nd:Yag laser (neodymium yag laser) hyaloidotomy (1), pneumatic displacement of bleeding via intravitreal gas and/or tissue plasminogen activator injection (5), and ultimately pars plana vitrectomy can be performed (6).

Nd:Yag laser is used in various pathologies involving the anterior segment in ophthalmology practice. For example: iridotomy or posterior capsulotomy (7). By puncturing the posterior hyaloid membrane non-invasively with the Nd:Yag laser, the bleeding trapped in the subhyaloid area can be drained. Thus, the drainage of subhyaloid hemorrhage into the vitreous is ensured, the absorption of blood cells is facilitated and vision can improve quickly (8). Nd:Yag laser is an alternative, safe method in the treatment of vitreous drainage of subhyaloid hemorrhage (9).

While Nd:Yag laser hyaloidotomy is a well-established treatment, there is limited data on its effectiveness across diverse etiologies and in patients with varying hemorrhage sizes and durations. This study aimed to present the etiology, patient characteristics and outcome of the Nd:yag laser hyaloidotomy procedure performed for subhyaloid hemorrhage due to different etiologies, which reduced vision in 14 patients.

METHODS

The study was carried out in accordance with the tenets of the Declaration of Helsinki. Written informed consent for the use of medical information of patients was received from all of the participants. This study was approved by the local Human Clinical Research and Ethics committee (Approval code: TÜTF-GOBAEK 2025/107).

In this study, the data of patients who were diagnosed with subhyaloid hemorrhage for various reasons and underwent Nd:Yag laser hyaloidotomy between January 2022 and January 2024 were retrospectively examined. Best-corrected visual acuity (BCVA) was measured with Snellen chart in all patients at each visit. Biomicroscopic examination was performed and intraocular pressure was measured. Fundus examination was performed with a +90D (Volk) lens. Optical coherence tomography (OCT) of the patients passing through the hemorrhage area was performed and it was confirmed that the hemorrhage was in the subhyaloid area. Inclusion criteria: Having complaints for less than 1 month, having subhyaloid hemorrhage greater than 3 optic disc (OD) diameters, having no anterior segment or vitreous opacity that would prevent Nd:Yag laser hyaloidotomy. When deciding to perform Nd:Yag laser hyaloidotomy on patients, care was taken to ensure that the bleeding area was in the macular area that would reduce visual acuity and that the bleeding area was larger than 3 OD, which is the minimum area shown by previous studies (10) to be unlikely to resolve with follow-up. The extent of bleeding was measured manually by the same person using color fundus photography. History of systemic diseases such as diabetes, hypertension, trauma, previous eye surgery, family history, and bleeding disorders were collected. Before performing Nd:yag laser hyaloidotomy on patients, the procedure was explained in detail. Patients were followed up at 1 week and 1 month post-procedure, with additional visits scheduled as needed based on clinical findings.

Nd:Yag Laser Hyaloidotomy Procedure Steps

Patients diagnosed with subhyaloid bleeding were informed about the procedure and consent was obtained. Mydriasis was achieved with 1% cyclopentalate and 1% tropicamide. Before the procedure, topical anesthesia was applied with 0.5% proparacaine hydrochloride. The procedure was performed with Ellex Ultra Q™ - YAG Laser device through Volk QuadrAspheric® Lens. The target point where the two laser lights reflected from the device overlapped was chosen as the inferior border of the subhyaloid hemorrhage, which is as far away from the fovea as possible. The reason for choosing the target light inferior to the hemorrhage was to ensure that the blood that would drain into the vitreous would be drained completely by capturing the appropriate opening. Care was taken to ensure that the target beams were away from the retinal vessels as well as the fovea. The power was increased starting from 2,5 mJ to the area targeted to create an opening and up to 10 mJ until an opening was created. A maximum of 10 shots were fired. The criterion for success was to see the flow of blood under the hyaloid membrane to the vitreous (Figure 1). With the help of OCT, subhyalodic hemorrhage areas and post-procedure images were recorded (Figure 2).

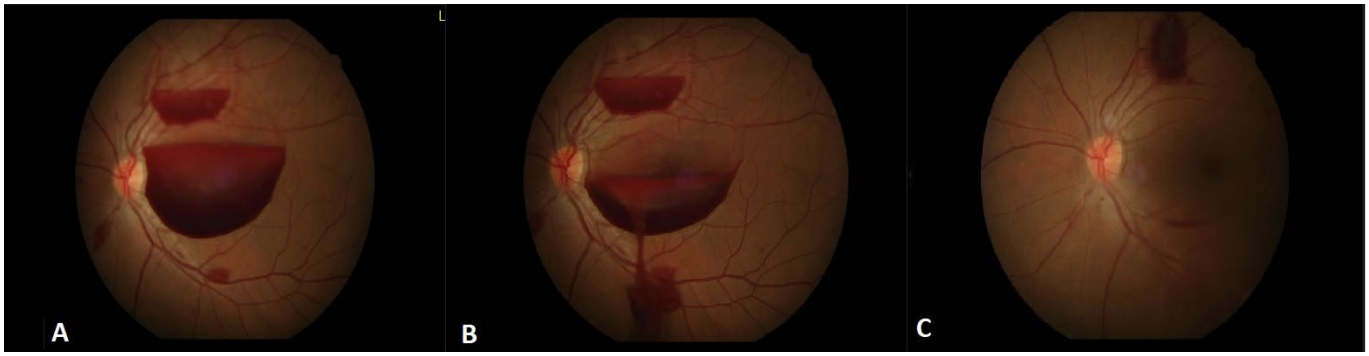

Figure 1. *A) Fundus photograph taken at the time of admission, showing subhyaloid hemorrhage. B) Fundus photograph taken 10 minutes after Nd:Yag laser hyaloidotomy. C) Fundus photograph taken 1 week after Nd:Yag laser hyaloidotomy.*

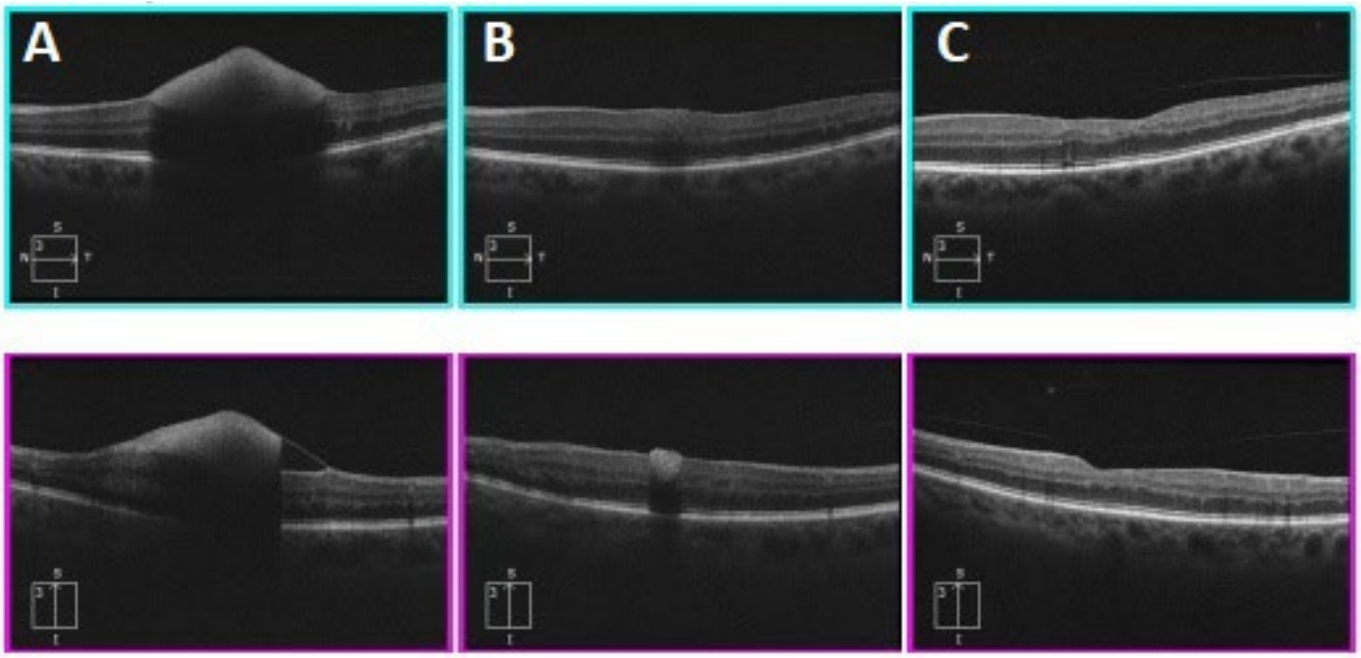

Figure 2. *A) Hyperreflective image of subhyaloid hemorrhage secondary to RVO and overlying intact hyaloid membrane on OCT. B) In the OCT image of the same case at the 1st week after Nd:Yag laser hyaloidotomy, it is seen that subhyaloid hemorrhage has decreased significantly. C) In the OCT image of the same case at the 1st month after Nd:Yag laser hyaloidotomy, it is seen that the subhyaloid hemorrhage has completely resolved.*

RESULTS

14 eyes of 14 patients were included in this study. 7 of the patients were female (50%) and 7 were male (50%). The mean age was 50.71±17.19 (range: 24-76). The mean BCVA detected at the first admission was 1.22±0.35 logMAR (range: 0.40-1.50). The average diameter of subhyaloid hemorrhage determined by fundus photography was 7.14±3.27 OD (range: 3-15 OD). The average time between complaints and application was 12.07±10.77 days (range: 1-40). When etiologies were examined, valsalva retinopathy (VR) was detected in 6 patients (42.9%), proliferative diabetic retinopathy (PDR) in 4 patients (28.6%), retinal vein occlusion (RVO) in 2 patients (14.3%), choroidal neovascularization (CNV) due to age-related macular degeneration in 1 patient (7.1%), and retinal macroaneurysm (RMA) in 1 patient (7.1%).

Patient compliance was quite good because the procedure was explained to the patients in detail before the procedure and it was a painless, short-term procedure. They had

floaters, which started after the procedure and gradually decreased in intensity in the following days.

At the 1st week visit, the mean BCVA was determined as 0.47±0.41 logMAR (range: 0.10-1.30). At the 1st month visit, the average BCVA was found to be 0.26±0.38 logMAR (range: 0-1.00). 1st week and 1st month BCVAs were statistically significantly higher than the initial admission BCVA ($p<0.001$). (Figure 3)While the subhyaloid hemorrhage drained into the vitreous through the created opening and was subsequently absorbed from the vitreous, the procedure was successful in 13 patients, while no opening was formed in 1 patient (Table 1). When the patient with no patency was examined, it was seen that the patient was 44 years old and applied on the 40th day of his complaints and a hemorrhage of 15 OD was detected. The etiological factor was determined to be VR. BCVA was determined as 1.50 at the first application. It was observed that BCVA was 0.50 1 week after the intervention and successful drainage was not achieved but the intensity of the hemorrhage decreased. This patient was followed up for 3 months and it was seen that the subhyaloid hemorrhage was spontaneously resorbed and BCVA increased to 0.00 logMAR.

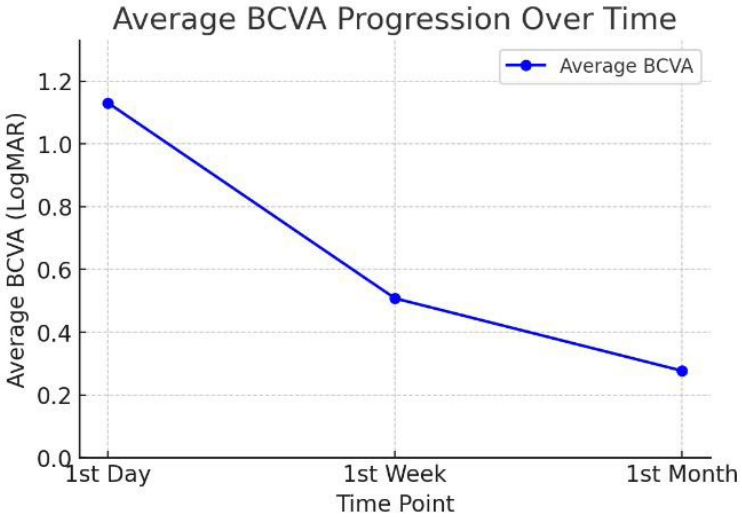

Figure 3. *Mean BCVAs at the first examination and at 1 week and 1 month after the procedure.*

Table 1. Clinical information of patients who successfully applied Nd:Yag laser hyaloidotomy

	Age	Sex	Diagnosis	Diameter (OD)	Time (Day)*	1st day BCVA**	Successful	1st week BCVA**	1st month BCVA**
1	40	F	VR	10	1	1,50	Yes	,10	,00
2	27	F	VR	5	4	1,50	Yes	,60	,00
3	76	M	CNV	9	3	1,50	Yes	1,30	1,00
4	24	F	VR	6	5	,70	Yes	,10	,00
5	63	F	RVO	3	4	1,30	Yes	,10	,00
6	40	M	PDR	9	5	1,00	Yes	,50	,40
7	55	F	PDR	10	11	1,50	Yes	1,50	1,00
8	55	F	RMA	3	25	,40	Yes	,20	,00
9	70	M	PDR	5	20	1,00	Yes	,80	,40
10	56	F	PDR	4	15	1,00	Yes	,70	,70
11	27	M	VR	7	6	1,30	Yes	,20	,00
12	68	M	VR	7	15	,50	Yes	,30	,00
13	65	M	RVO	7	6	1,50	Yes	,20	,10

* Number of days from the day the complaints started to the day the patient applied to the clinic

**LogMAR

M: Male, F: Female, VR: Valsalva Retinopathy, CNV: Choroidal Neovascularization, RVO: Retinal Vein Occlusion, val: Proliferative Diabetic Retinopathy, RMA: Retinal Macroaneurysm, OD: Optic Disc

Panretinal photocoagulation was applied to 3 patients with PDR as additional treatment. Intravitreal bevacizumab injection was administered to a total of 6 patients: 3 patients diagnosed with PDR, 2 patients with RVO, and 1 patient with CNV.

DISCUSSION

In this study, 14 eyes of 14 patients who underwent Nd:Yag laser hyaloidotomy due to subhyaloid hemorrhage were examined. The number of women and men in the study was equal. The mean BCVA logMAR at presentation, in the first week and in the first month of the procedure were determined as 1.13, 0.51 and 0.28, respectively. When the etiologies of subhyaloid hemorrhage were examined, VR was detected in 6 patients (42.9%), PDR in 4 patients (28.6%), RVO in 2 patients (14.3%), CNV due to age-related macular degeneration in 1 patient (7.1%) and RMA in 1 patient (7.1%). Successful results were obtained with Nd:Yag laser hyaloidotomy in 13 of 14 patients. The etiology of the patient who did not receive successful results was VR and it was observed that he applied on the 40th day of his complaints and a hemorrhage measuring 15 OD was detected. This study is valuable because it is a case series of 14 eyes with different etiologies that demonstrates that Nd:YAG laser hyaloidotomy is effective in the treatment of subhyaloid hemorrhage regardless of etiology and produces significant visual gain.

In subhyaloid hemorrhages, there is a sudden and severe loss of vision. When monitored, this hemorrhage may spontaneously resolve on its own (11). However, if left untreated, it can lead to permanent vision damage by causing pigment changes in the macula, particularly in the fovea, as well as the formation or worsening of an epiretinal membrane (6). Additionally, when the hemorrhage remains in the subhyaloid space, the retina can be exposed to hemoglobin and iron for an extended period, leading to toxicity and potentially irreversible vision loss (1, 12). The treatment options for subhyaloid hemorrhages, apart from monitoring, include Nd:Yag laser hyaloidotomy and vitrectomy. Since vitrectomy is a surgical procedure, it carries more risks (13). On the other hand, Nd:Yag laser hyaloidotomy is a brief procedure performed in an outpatient setting. The drainage of subhyaloid hemorrhage using Nd:Yag laser was first described in the 1980s (3, 14). Nd:Yag laser hyaloidotomy is used for subhyaloid hemorrhages that have occurred due to various reasons. The most common of these is VR (15). Other causes may include proliferative diabetic retinopathy, retinal vascular occlusions, retinal artery macroaneurysm, choroidal neovascularization, or hemorrhages due to blood disorders such as leukemia (3, 16). In this study, 14 patients with subhyaloid hemorrhage who underwent Nd:Yag laser hyaloidotomy were examined. Six of the patients (42.9%) had VR, a result consistent with the fact that VR is the most common cause of subhyaloid hemorrhages (17). However, Murtaza et al.(9) reported that 15 out of 30 patients in their study from Pakistan had PDR. This may be related to the higher prevalence of diabetes mellitus in that region. Similarly, in another study conducted by Khadka et al.(1) in Nepal, 22.72% of the patients were diagnosed with VR, making it the most common etiology. In this series, the authors also mentioned high altitude-related subhyaloid hemorrhages in the mountains of Nepal.

Hyaloidotomy aims to create a small opening to allow the accumulated blood to flow into the vitreous cavity. The timing of the procedure is therefore crucial. Previous studies have demonstrated that if the blood is left for too long, it coagulates and fails to drain into the vitreous cavity (10, 18). Khan et al. followed up 11 patients who underwent hyaloidotomy after detection of VR and reported the drainage time as 1-30 days (19). Murtaza et al.(9) performed Nd:Yag laser hyaloidotomy on 30 patients with subhyaloid hemorrhage of different etiologies and found the mean time for blood to drain into the vitreous as 14.5 (6-23) days. Similarly, in this study, the mean time for drainage of subhyaloid hemorrhage into the vitreous was 12.07 days. In another study, this period was found to be 1 week (20). The reason for the different results may be that patient visits were made at different times. Regardless of diagnosis, BCVA of all patients was observed to have increased at the first week and first month follow-up. Nd:Yag laser hyaloidotomy should be applied to suitable patients as soon as possible. Because the blood trapped in the subhyaloid area coagulates over time. In this study, it is seen that an effective opening could not be created in the patient who applied on the 40th day of the onset of the complaint.

The laser power to be used when performing Nd:Yag laser hyaloidotomy is controversial. According to other studies,

the laser power varies between 2.5-50 mJ (10, 14, 21). In this study, the values between 2.5-10 mJ were studied, taking into account other studies. When performing Nd:Yag laser hyaloidotomy for subhyalodic hemorrhages, care should be taken to ensure that it is performed away from the major vascular arch and the fovea.

In the study conducted by Sonmezoglu et al. (22), different etiological factors were considered and the mean age was reported as 52.03. In another study, cases with etiologically detected VR were included and the mean age was determined as 40.9 (19). In this study, the mean age of the patients was determined as 50.71±17.19 and the only unsuccessful case was 44. The mean age is consistent with the literature where different etiological factors were included, but VR can be seen at younger ages compared to PDR. It is thought that the success of Nd:Yag laser hyaloidotomy does not depend on age and etiological factors. However, the final BCVA may depend on the underlying etiological factor.

In addition, previous studies have suggested that the existing bleeding area should be larger than 3 OD in diameter to prevent laser-related complications (10). In this study, the average diameter of subhyaloid hemorrhage is 7.14 OD. The smallest area is seen as 3 OD and the largest area is 15 OD. The patient with a 15 OD subhyaloid hemorrhage area is also seen as the latest application to the clinic after the onset of symptoms in the series, it is understood that he applied 40 days later. The subhyaloid hemorrhage area of this patient could not be opened to the vitreous with Nd:Yag laser hyaloidotomy. The large hemorrhage and the later application time compared to other patients may have caused this.

In previous studies, the success rates of Nd:Yag laser hyaloidotomy applied to subhyaloid hemorrhage were reported as 70-90%. Khadka et al. (1) reported the success rates as 86.4% in their study. Ulbig et al. (10) found it as 76.1%. In their study, Sonmezoglu et al. (22) achieved success with Nd:Yag laser hyaloidotomy in 34 of 39 eyes and presented a success rate of 87.17%. The success rate in this study was found to be 93% and is consistent with the literature.

Various complications have been reported in patients who underwent Nd:Yag laser hyaloidotomy. In a study reporting long-term follow-up results of 21 patients, 1 patient had a macular hole, 1 myopic patient had retinal detachment, and 4 patients had persistent vitreous hemorrhage. It has been stated that high laser power may be responsible for the formation of macular holes and retinal detachment (10). Kwok et al. reported the development of an epiretinal membrane after Nd:Yag laser hyaloidotomy (23). In this study, subhyaloid hemorrhage did not drain into the vitreous in one patient. Apart from this, no complications such as macular holes, retinal detachment, or persistent vitreous hemorrhage were observed in any of the patients. This may be due to keeping the laser power below 10 mJ and applying the laser beam away from the major vascular arches and the fovea, considering other studies.

The small sample size and retrospective nature of the study limit the generalizability of the findings. Additionally, the short follow-up period (1 month) may not capture long-term complications or recurrence of hemorrhage.

In conclusion, Nd:Yag laser hyaloidotomy is a cheap, effective and safe method used in subhyaloid hemorrhages due to different etiologies. It is advantageous to provide outpatient services in polyclinic conditions. It can provide rapid visual recovery to patients with only one eye or who feel the need to see clearly while working. It can help to detect the underlying cause at an earlier stage. If the detected disease requires treatment, it can accelerate the initiation of treatment.

REFERENCES

1. Khadka D, Bhandari S, Bajimaya S, Thapa R, Paudyal G, Pradhan E. Nd:YAG laser hyaloidotomy in the management of Premacular Subhyaloid Hemorrhage. BMC Ophthalmol. 2016;16:41.
2. Kirwan RP, Cahill MT. Nd:YAG laser hyaloidotomy for valsalva pre-macular haemorrhage. Ir J Med Sci. 2011;180(3):749-52.
3. Durukan AH, Kerimoglu H, Erdurman C, Demirel A, Karagul S. Long-term results of Nd:YAG laser treatment for premacular subhyaloid haemorrhage owing to Valsalva retinopathy. Eye (Lond). 2008;22(2):214-8.
4. Göktuğ SEYMENOĞLU ÖK, Meliha CİNALİ. Çeşitli Etiyolojilere Bağlı Premaküler Subhyaloid Hemorajilerde Nd:YAG Lazer Arka Hyaloidotomi. Retina-Vitreus/Journal of Retina-Vitreous. 2010;18(1).
5. Conway MD, Peyman GA, Recasens M. Intravitreal tPA and SF6 promote clearing of premacular subhyaloid hemorrhages

in shaken and battered baby syndrome. Ophthalmic Surg Lasers. 1999;30(6):435-41.

6. O'Hanley GP, Canny CL. Diabetic dense premacular hemorrhage. A possible indication for prompt vitrectomy. Ophthalmology. 1985;92(4):507-11.
7. Geerling G, Roider J, Schmidt-Erfurt U, Nahen K, el-Hifnawi el S, Laqua H, Vogel A. Initial clinical experience with the picosecond Nd:YLF laser for intraocular therapeutic applications. Br J Ophthalmol. 1998;82(5):504-9.
8. Rennie CA, Newman DK, Snead MP, Flanagan DW. Nd:YAG laser treatment for premacular subhyaloid haemorrhage. Eye (Lond). 2001;15(Pt 4):519-24.
9. Murtaza F, Rizvi SF, Bokhari SA, Kamil Z. Management of Macular Pre-Retinal Subhyaloid hemorrhage by Nd:Yag laser hyaloidotomy. Pak J Med Sci. 2014;30(2):339-42.
10. Ulbig MW, Mangouritsas G, Rothbacher HH, Hamilton AM, McHugh JD. Long-term results after drainage of premacular subhyaloid hemorrhage into the vitreous with a pulsed Nd:YAG laser. Arch Ophthalmol. 1998;116(11):1465-9.
11. Duane TD. Valsalva hemorrhagic retinopathy. Am J Ophthalmol. 1973;75(4):637-42.
12. Glatt H, Machemer R. Experimental subretinal hemorrhage in rabbits. Am J Ophthalmol. 1982;94(6):762-73.
13. De Maeyer K, Van Ginderdeuren R, Postelmans L, Stalmans P, Van Calster J. Sub-inner limiting membrane haemorrhage: causes and treatment with vitrectomy. Br J Ophthalmol. 2007;91(7):869-72.
14. Gabel VP, Birngruber R, Gunther-Koszka H, Puliafito CA. Nd:YAG laser photodisruption of hemorrhagic detachment of the internal limiting membrane. Am J Ophthalmol. 1989;107(1):33-7.
15. Kaynak S, Eryildirim A, Kaynak T, Durak I, Saatci O, Eryildirim S, Ozcan Y. Nd:YAG laser posterior hyaloidotomy in subhyaloid hemorrhage. Ophthalmic Surg. 1994;25(7):474-6.
16. Ezra E, Dowler JG, Burgess F, Sehmi K, Hamilton PA. Identifying maculopathy after neodymium: YAG membranotomy for dense diabetic premacular hemorrhage. Ophthalmology. 1996;103(10):1568-74.
17. Mennel S. Subhyaloidal and macular haemorrhage: localisation and treatment strategies. Br J Ophthalmol. 2007;91(7):850-2.
18. Cheung CM, Benson MT. Post-chemotherapy premacular subhyaloid haemorrhage. Eye (Lond). 2003;17(1):97-9; author reply 114.
19. Khan MT, Saeed MU, Shehzad MS, Qazi ZA. Nd:YAG laser treatment for Valsalva premacular hemorrhages: 6 month follow up : alternative management options for preretinal premacular hemorrhages in Valsalva retinopathy. Int Ophthalmol. 2008;28(5):325-7.
20. Celebi S, Kukner AS. Photodisruptive Nd:YAG laser in the management of premacular subhyaloid hemorrhage. Eur J Ophthalmol. 2001;11(3):281-6.
21. Kuruvilla O, Munie M, Shah M, Desai U, Miller JA, Ober MD. Nd:YAG membranotomy for preretinal hemorrhage secondary to valsalva retinopathy. Saudi J Ophthalmol. 2014;28(2):145-51.
22. Sonmezoglu BG CE, Sonmezoglu HI, Boz AAE. Nd: Yag laser hyaloidotomy in the treatment of premacular subhyaloid haemorrage. Journal of Retina Vitreus 2024(33):266-72.
23. Kwok AK, Lai TY, Chan NR. Epiretinal membrane formation with internal limiting membrane wrinkling after Nd:YAG laser membranotomy in valsalva retinopathy. Am J Ophthalmol. 2003;136(4):763-6.