Early Vitrectomy for Spontaneous, Fundus-Obscuring Vitreous Hemorrhage

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• PURPOSE: To examine the visual outcomes of early intervention in the setting of fundus-obscuring vitreous hemorrhage (VH) presumed to be due to posterior vitreous detachment.

• DESIGN: Retrospective comparative case series.

• METHODS: All eyes that presented with a fundus-obscuring VH, defined as vision of 20/400 or worse and requiring a B-scan at presentation from 2003 to 2013, were evaluated. Eyes with any history of retinopathy, macular degeneration, recent trauma, presentation greater than 2 weeks after onset of symptoms, or follow-up of less than 2 months were excluded. The main outcome measure studied was final best-corrected visual acuity (BCVA) as dependent on the time to surgery.

• RESULTS: Ninety-two eyes met inclusion criteria with a mean follow-up of 490 days. Initial BCVA was logMAR 2.218 (Snellen equivalent 20/3000-20/4000, range 20/400-light perception); final BCVA was 0.318 (Snellen equivalent of 20/40-20/50, range 20/20-light perception, $P < .001$). Fifty-six patients (60.8%) had either a retinal tear or a retinal detachment. Patients who underwent surgery within 1 week had no significant improvement over all others; however, a significant improvement was found when comparing early vs delayed surgery groups ($P < .05$). There was a significantly increased risk of developing a macula-off retinal detachment in patients who did not undergo surgery within 1 week of presentation.

• CONCLUSIONS: Early surgical intervention results in similar visual outcomes compared to a conservative approach. However, early intervention significantly reduces the incidence of severe vision loss related to macula-involving retinal detachment. This study highlights the importance of close follow-up given the high risk of retinal detachment in fundus-obscuring vitreous hemorrhage. (Am J Ophthalmol 2015;160(5): 1073–1077. © 2015 by Elsevier Inc. All rights reserved.)

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ACUTE, SPONTANEOUS POSTERIOR VITREOUS detachment (PVD) has been associated with a reported 10%–15% incidence of retinal tears.[1] However, when acute PVD is associated with vitreous hemorrhage, the incidence of retinal tears rises to reported rates of 54%–91%.[2–8]

In the setting of a dense fundus-obscuring vitreous hemorrhage, the clinical examination is made more difficult by an inability to visualize the fundus. In these cases, B-scan ophthalmic ultrasonography is used to rule out an underlying retinal tear or detachment. Studies looking at the accuracy of ultrasonography in determining the presence of retinal tears have demonstrated variable results.[9,10] Given the high risk of underlying retinal pathology, an important consideration becomes whether early surgical intervention with pars plana vitrectomy (PPV) results in improved visual and anatomic outcomes as compared to careful monitoring. The decision to intervene must balance the risks of vitrectomy vs the risk of missing an underlying tear and not responding in a timely fashion.[11–13]

Several noncomparative studies have looked at the question of appropriate patient management in patients with an acute dense vitreous hemorrhage in the setting of PVD. One retrospective observational case series concluded that the incidence of underlying pathology is high but close observation is appropriate in many cases, except in those individuals who have a history of retinal detachment in the contralateral eye.[14] Two studies analyzed patients treated with early vitrectomy and concluded that surgical management is both safe and effective.[15,16] A gap in the literature has been a study comparing 2 management approaches in a similar setting. We set out to design a comparative analysis to determine whether, in patients presenting with a dense, fundus-obscuring vitreous hemorrhage from presumed PVD, early surgical intervention results in improved patient outcomes.

METHODS

THIS INVESTIGATION WAS CONDUCTED WITH THE approval of the Medstar Health Research Institute review board. A retrospective observational case series was performed of 92 eyes of 92 patients with acute, spontaneous fundus-obscuring vitreous hemorrhage. These patients were identified after a review of 4232 charts with the diagnosis code for vitreous hemorrhage (ICD-9 379.23) from

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January 1, 2003 to October 1, 2013 at a large retina-only subspecialty medical practice. Exclusion criteria included a history of any vascular retinal disease (including diabetic retinopathy), uveitis, or wet macular degeneration in either eye; previous intraocular surgery other than uncomplicated cataract or refractive surgery; and history of recent trauma. Furthermore, patients were excluded if initial presentation was greater than 2 weeks after the onset of symptoms or if follow-up duration was less than 2 months. Finally, patients were excluded if the vitreous hemorrhage was thought to be likely from a cause other than spontaneous PVD, including neovascularization from retinal vein occlusion or retinal arterial macroaneurysm. Inclusion criteria included vision of 20/400 or worse and an ultrasonography scan (B-scan) at the first visit, which indicated that the vitreous hemorrhage was fundus obscuring.

All relevant data from each patient's progress notes, surgical records, and ancillary testing were abstracted into a standardized data collection sheet that was used in a structured database program for analysis. Patient data recorded from office charts on initial presentation included patient age, sex, involved eye, lens status, the presence or absence of diabetes or hypertension, best-corrected visual acuity (BCVA), and B-scan ultrasound results. The actual B-scan images were not reviewed. Follow-up information recorded included, where applicable, time to spontaneous clearing of the hemorrhage, time to detection of macula-on or macula-off retinal detachment, time to surgical intervention, and indication for surgery. Total follow-up time, final BCVA, and final diagnosis were also noted.

At the initial examination, it was most often concluded that the hemorrhage was likely secondary to a PVD through analysis of the patients' symptoms, ophthalmic history, examination of the eyes, and ultrasound results. Most patients described a sudden, painless loss of vision in a previously normal eye, with variable reports of increased floaters or photopsias.

To determine the sensitivity and specificity of the preoperative clinical examination, we carefully reviewed the clinic note immediately prior to surgery to determine whether the findings of retinal tears or detachments at the office visit correlated with findings at the time of surgery.

• **STATISTICAL ANALYSIS:** For all subjects, visual acuity was determined using a Snellen chart. Logarithm of the minimal angle of resolution (logMAR)-converted best-corrected initial and final visual acuities were used for statistical comparison. For statistical analysis, counting fingers vision at 1 foot was assigned a Snellen equivalent of 20/4000, at 2 feet was 20/2000, and at 3 feet was 20/1333. Hand motions was assigned 20/8000 and light perception (LP) 20/16 000. Categorical data were analyzed by Fisher exact test and population means were compared by Student *t* test. Statistical significance was considered $P \leq .05$.

RESULTS

NINETY-TWO EYES OF 92 PATIENTS WHO HAD DENSE fundus-obscuring vitreous hemorrhage were included in the study. The series included 48 male and 44 female subjects, ranging in age from 41 to 96 years (mean 63.8). Eight patients had diabetes without any prior retinopathy, 47 had hypertension without any prior retinopathy, and 10 patients were on warfarin. The mean duration of symptoms was 3.9 days prior to presentation (range 0–14 days).

On initial examination the mean initial logMAR BCVA was logMAR 2.218 (Snellen equivalent 20/3000-20/4000, range 20/400-LP). Patients first presented on average 3.9 days after the onset of symptoms (±4.4 days, range 0–14). Fifty-two patients (56.5%) presented within 48 hours of symptom onset, with 25 more patients (27.2%) presenting at 3–7 days and 15 (16.3%) presenting between 1 and 2 weeks. The average duration of follow-up was 490 days with a median of 311 days.

During the course of this study, 72 patients underwent a surgical procedure performed by 1 of 13 surgeons. Six of these patients (1.6%) underwent cryotherapy or laser photocoagulation alone. Sixty-six patients (71.7%) underwent vitrectomy surgery, either alone (n = 62) or in combination with scleral buckling (n = 4). No other surgical procedures were performed as part of the initial management of the presenting condition. On review of operative records, no vision-threatening intraoperative complications were noted in cases where vitrectomy was performed.

Of the eyes that underwent vitrectomy (n = 66), 30 (45.5%) underwent surgical intervention within 7 days of first presentation (early vitrectomy). The 36 others (54.5%) underwent surgery more than 7 days after presentation (delayed vitrectomy). Average time to surgery in the delayed vitrectomy group was 40 days with a median of 29 days. Thirteen eyes were ultimately found to have a diagnosis other than PVD as a cause of the hemorrhage—6 eyes with macroaneurysm, 6 eyes with branch retinal vein occlusion and 1 eyes with central retinal vein occlusion.

Fifty-six of the 92 eyes (60.8%) were discovered to have either a retinal tear or a retinal detachment (RD) (35 RDs and 21 retinal tears). Of the RDs, 9 were macula-off and 26 were macula-on at the time of surgery. With regard to the distribution of macula-on RDs, 16 were found in the early vitrectomy group and 10 were found in the delayed vitrectomy group. All 9 of the macula-off detachments were in the delayed group. The mean time to diagnosis of macula-off RD was 27 days (range 11–60 days). The Figure demonstrates the distribution of days from presentation to the diagnosis of macula-off RD in patients who suffered this complication. Those patients that underwent surgery within the first week of presentation had a significantly lower risk of suffering a macula-off RD ($P < .05$).

Seventy patients in the study were phakic and 22 were pseudophakic at the time of presentation. Of the 35

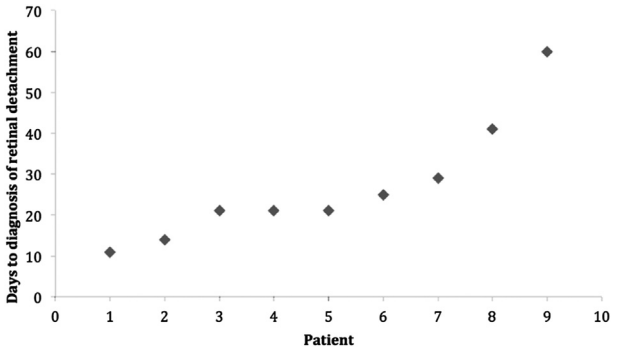

FIGURE. Time from initial presentation to the diagnosis of macula-off retinal detachment in patients who suffered this complication after developing a dense, fundus-obscuring vitreous hemorrhage. Figure illustrates the time between the initial presentation to our clinic and the discovery of a macula-off rhegmatogenous retinal detachment in each of the 9 patients who developed this complication.

patients with RD, 6 were pseudophakic and 29 were phakic at the outset. Lens status did not have a significant effect on the likelihood of developing an RD ($P > .05$). At the time of surgery, 10 patients were pseudophakic in the early vitrectomy group and 7 were pseudophakic in the delayed vitrectomy group. Lens status did not significantly correlate with the decision to proceed with early vs delayed vitrectomy ($P > .05$). Of the 26 patients who did not undergo vitrectomy, 21 were phakic at the start of the study and 20 remained phakic by study end. In contrast, in the group that underwent vitrectomy, 49 were phakic at the outset and 32 underwent cataract surgery by study end. Undergoing vitrectomy surgery correlated significantly with subsequent cataract surgery in the affected eye ($P < .05$).

Seven of the 56 patients (12.5%) with the diagnosis of retinal tear or RD had a history of retinal tear or detachment in the contralateral eye. Of the 36 patients without a retinal tear or detachment, 2 (5%) had a history or retinal tear or detachment in the contralateral eye. There was no statistically significant correlation between having had a retinal tear or detachment in the contralateral eye and having a retinal tear or detachment in the affected eye ($P > .05$).

Mean visual acuity improved in the entire cohort from initial presentation (logMAR 2.218, Snellen 20/3000-20/4000) to final follow-up (logMAR 0.318, Snellen 20/40-20/50), and this change was statistically significant ($P < .05$). There was no statistically significant difference in visual outcomes among patients that underwent vitrectomy within the first week of presentation (logMAR 0.235, Snellen 20/32-20/40) as compared to all others (logMAR 0.359, Snellen 20/40-20/50, $P > .05$). Similarly, there was no statistical difference between those who underwent early surgical intervention as compared to those who underwent no surgical intervention (logMAR 0.181, Snellen 20/30, $P > .05$). However, when looking only at patients who underwent surgical intervention, those who underwent early vitrectomy achieved a significantly better visual outcome as compared to those who did not (logMAR 0.488, Snellen 20/60-20/70; $P < .05$). Additionally, patients who suffered a macula-involving RD had a significantly worse visual acuity outcome (logMAR 0.722, Snellen 20/100-20/120; $P < .05$) than all others.

The presurgical examination (including clinical examination and B-scan ultrasonography, where indicated) had a sensitivity of 73.47% and a specificity of 88.24% in determining the presence of retinal tear or detachment. Moreover, the positive predictive value of clinical examination was 94.74% and the negative predictive value was only 53.57%.

DISCUSSION

DENSE FUNDUS-OBSCURING VITREOUS HEMORRHAGE IN the setting of an acute PVD is a serious ocular disorder. Most studies agree that there is a high incidence of underlying retinal pathology in these cases. There is also agreement that although some patients do quite well, there is a higher-than-normal risk of permanent vision loss related to associated complications such as macula-off RD. Some authors have suggested that because of the risk of severe vision loss, early vitrectomy may be considered.[14,15] Nevertheless, actual practice patterns vary and include conservative management with serial office-based examination, vitrectomy surgery, or some combination of the two. Previous studies on this topic have been mostly descriptive. In our study we sought to accomplish 2 things; to collect a series of cases enabling a complete review of the practice patterns of surgeons in a community-based retina practice, and to perform a retrospective comparative analysis looking at the effect of early surgical intervention on disease and visual outcome.

Several points regarding our analysis require further explanation. First, we made a decision to define early surgery as taking place within 7 days of patient presentation. This cut-off was chosen for the sake of analysis with the rationale that, in the absence of an emergency, 7 days provides a reasonable time frame for which a surgeon and patient could decide to proceed with early elective treatment. Second, we made the decision to exclude patients who had symptoms for more than 2 weeks prior to presentation because we felt that the management of patients in the acute setting would be different from that of patients who had longstanding vision loss.

Despite exclusion criteria carefully chosen to define our population as those who presented with hemorrhage from presumed PVD, 13 patients were ultimately found to have bleeding from other vascular conditions. This result is consistent with other studies in the literature.[14] We felt it important to include these patients in the analysis

because these false-positive results should be taken into account when making management decisions.

Consistent with the literature, we found a high rate of vitrectomy surgery in patients presenting with dense fundus-obscuring vitreous hemorrhage to our retinal center. Similarly, we found a high rate of retinal tears and retinal detachments in this patient population. When taken as a whole, we found that patients with this disorder can expect a significant improvement in visual acuity over time.

There was an equal distribution of retinal detachments in the early vitrectomy and the watchful waiting (defined as observation with the possibility of delayed surgery) groups; however, those in the latter group had a significantly higher incidence of the more severe, macula-off retinal detachments. The mean time to diagnosis of macula-off RD was 27 days, suggesting that this complication often occurred weeks after initial presentation, during the time that the patient was under the care of a retina specialist. It is beyond the scope of this retrospective review to suggest whether more frequent observation or more careful ultrasonography may have limited the incidence of this complication. However, it is clear that a high index of suspicion and extended follow-up is warranted in patients with dense vitreous hemorrhages who are monitored in the clinic setting.

An analysis of lens status upon presentation did not reveal any characteristics that would help stratify the patients' risk of developing a retinal detachment. Stated another way, both phakic and pseudophakic patients had a statistically similar chance of developing a retinal detachment. Not surprisingly, phakic patients who underwent vitrectomy surgery had a higher chance of requiring subsequent cataract surgery. This finding has been described elsewhere and should play a role in the clinician's discussion of the risks and benefits of the proposed surgical procedure.[17]

Our finding that there is a relatively low negative predictive value of the preoperative clinical examination is also not entirely surprising. The negative predictive value refers to the probability that a retinal tear is truly absent when it is not detected at the office visit. Others have noted that B-scan is inconsistently reliable in detecting retinal pathology such as small tears underlying a vitreous hemorrhage.[18] This finding further supports the argument for considering surgical intervention not only as a therapeutic but also as a diagnostic tool in the management of fundus-obscuring vitreous hemorrhage.

Visual acuity data indicated that early surgery offered neither an advantage nor a disadvantage when compared to watchful waiting. This may seem confusing in light of the fact that more macula-involving RDs were found in the watchful waiting group. However, it is important to note that statistical analysis is a measure of mean values. Very likely, the poor outcomes of patients with macula-involving RDs were balanced somewhat by the good outcomes of those patients who underwent no surgical intervention and whose hemorrhages cleared spontaneously.

In a real-life clinical encounter the decision to manage the patient who presents with an acute, dense, fundus-obscuring hemorrhage is a complex one. Clinical findings, including B-scan ultrasonography, are important and, in the case of a retinal detachment, may present a clear, emergent indication for surgery. In the absence of an emergent indication, other factors such as associated health issues, the risks of surgery, and the patient's informed preference all may play a role in the surgeon's decision.

Our analysis has several limitations, some of which are inherent to the retrospective study design. First, although it would be interesting to note, the surgeon's decision-making process is not always clear from a review of office notes because of variability in the degree of documentation provided. Second, measures of visual acuity use Snellen rather than the standardized ETDRS acuity. Third, and most important, is the inability to standardize treatment protocols. Some surgeons may observe patients daily, whereas others may recommend a less strict monitoring protocol. The frequency of B-scan examinations and the type of equipment used may also affect outcomes. A standardized, prospective protocol would more accurately determine if serial monitoring is as effective as early vitrectomy in avoiding the severe complication of macula-involving rhegmatogenous retinal detachment. Further prospective analysis is needed to address this complex clinical problem.

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Biosketch

Alexander Melamud served as resident and chief resident at the Cleveland Clinic's Cole Eye Institute and went on to complete a fellowship in vitreo-retinal disease at the Duke University Medical Center. He is currently a partner with The Retina Group of Washington and co-director of the fellowship program administered by The Retina Group of Washington in conjunction with Georgetown University and the Washington Hospital Center.