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ORIGINAL ARTICLE

Visual and Anatomical Outcomes of Early versus Delayed Vitrectomy in Diabetic Vitreous Hemorrhage

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ABSTRACT

Background: Diabetic vitreous hemorrhage (VH) is a major cause of sudden vision loss in patients with proliferative diabetic retinopathy (PDR).

Objective: To compare the visual and anatomical outcomes of early versus delayed pars plana vitrectomy in patients presenting with diabetic vitreous hemorrhage.

Methods: This comparative interventional study was conducted at Lahore General Hospital, Lahore from September 2022 to February 2023, including 185 patients diagnosed with diabetic vitreous hemorrhage. Patients were divided into two groups: Group A underwent early vitrectomy within six weeks of hemorrhage onset, and Group B underwent delayed vitrectomy after six weeks of observation. All patients underwent 25-gauge PPV with intraoperative panretinal photocoagulation (PRP). Best-corrected visual acuity (BCVA) was measured preoperatively and at one, three, and six months postoperatively.

Results: Among 185 patients, 92 underwent early and 93 underwent delayed vitrectomy. The mean age was 54.3 ± 8.7 years in the early group and 55.8 ± 9.2 years in the delayed group. At six months, mean postoperative BCVA improved from 1.88 ± 0.24 to 0.68 ± 0.19 logMAR in the early group and from 1.85 ± 0.27 to 0.91 ± 0.23 logMAR in the delayed group ($p < 0.001$). Anatomical success was achieved in 97.8% of early cases and 91.4% of delayed cases ($p = 0.06$). Recurrent vitreous hemorrhage occurred in 10.9% of early cases and 22.6% of delayed cases ($p = 0.03$). The mean operative time was significantly shorter in the early group (64.2 ± 11.3 vs. 79.6 ± 14.7 minutes; $p < 0.001$).

Conclusion: It is concluded that early vitrectomy provides better visual recovery, faster rehabilitation, and fewer postoperative complications compared to delayed vitrectomy in diabetic vitreous hemorrhage.

Keywords: Diabetic vitreous hemorrhage, Early vitrectomy, Delayed vitrectomy, Pars plana vitrectomy, Visual outcomes

INTRODUCTION

Diabetes mellitus is a major global health problem with a rapidly increasing prevalence, particularly in low- and middle-income countries. Long-standing high blood sugar damages blood vessels, making diabetic retinopathy (DR) one of the most serious and sight threatening complications[1]. Out of the more serious forms of DR, proliferative diabetic retinopathy (PDR) is one of the most preventable forms of vision loss in working adults[2]. PDR is dangerous because of the growth of abnormal blood vessels in the retina, and these blood vessels can bleed and block sight, leading to a rapid deterioration of vision. Such events often lead to PDR vision loss and the rupture of these blood vessels is a means to cause full vision loss. In less serious ruptures, the blood may dissipate by itself[3]. However, most ruptures are serious as the body may keep bleeding, thus a surgical solution becomes the only means of treatment. The common diabetic blood vessel surgeries (vitrectomy) are aimed at removing the blood and allowing the retina to be treated[4]. The debate surrounding surgical intervention is based on how soon is too soon to operate when vision cannot be re-gained, and how long too long to wait when surgical risks are involved. Originally, the Diabetic Retinopathy Vitrectomy Study (DRVS) was the first to provide chronological evidence to capture the correct timing of surgery[5]. DRVS compared an era of early (within weeks of VH onset) with a late (12 months after onset of VH, if persistent) Vitrectomy. This study showed that early surgery was significantly related to desirable outcomes amongst the Type 1 Diabetics compared to Type 2 Diabetics. Although relevant, the DRVS was conducted at a historical time where 20-gauge instruments, longer surgical time, and more complications with surgery were the norms of surgical technology[6]. Thus, how relevant and applicable in the era of Modern micro-incision Vitrectomy is also questioned. There have been advances in Vitreoretinal Surgery over the past decades. In Vitreoretinal Surgery, Modern techniques, and improved systems of intraoperative visualization, Wide-angle viewing and high-speed cutters for pars plana vitrectomy (PPV) at 23, 25, 27 gauge have been seen to decrease surgical morbidity (i.e the surgery is safer) and have improved surgical outcomes[7]. The intraoperative bleeding was minimized, there was stabilization of neovascularization and surgical safety improved. This is also due to the preoperative anti-vascular endothelial growth factor (anti-VEGF) agents. Early Vitrectomy is now safer and more effective and consequently, the higher risk of performing early Vitrectomy is a thing of the past[8]. In the context of all these factors, there have been several other recent studies that have focused on the early versus. delayed Vitrectomy. Research indicates that early PPV done within 4 to 6 weeks of the start of the hemorrhage results in faster visual recovery and a lower risk of complications such as neovascular glaucoma and tractional retinal detachment[9]. Early PPV also allows for the completion of panretinal photocoagulation, which, in turn, helps to prevent further bleeding and enhances the long-term stability of the anatomy[10]. This is in contrast to a delay, which can result in a longer period of visual disability, loss of productivity, and the development of fibrovascular proliferation that leads to tractional retinal detachment and other poor outcomes in the anatomy[11-13].

Objective: To compare the visual and anatomical outcomes of early versus delayed pars plana vitrectomy in patients presenting with diabetic vitreous haemorrhage.

METHODOLOGY

This was a comparative interventional study conducted at Lahore General Hospital, Lahore from September 2022 to February 2023. A total of 185 patients diagnosed with diabetic vitreous hemorrhage were included in the study. Non-probability consecutive sampling was used to recruit eligible participants.

Inclusion Criteria: Patients aged 30–70 years with proliferative diabetic retinopathy presenting with non-clearing vitreous hemorrhage were included. Both type 1 and type 2 diabetic patients were eligible.

Exclusion Criteria: Patients with previous vitrectomy, concurrent retinal detachment, dense cataract precluding visualization, neovascular glaucoma, or other ocular pathologies affecting visual acuity were excluded.

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Data Collection: Demographic details including age, gender, duration and type of diabetes, and baseline ocular status were recorded for all patients. Participants were stratified into two groups based on when vitrectomy was performed. Group A (early vitrectomy) consisted of patients who had received a pars plana vitrectomy within 6 weeks of the initial onset of a vitreous hemorrhage; while Group B (delayed vitrectomy), consisted of patients who had the procedure 6 weeks later, after being observed with no incident of spontaneous clearance. These groups were created in order to assess the impact of the timing of the surgery on visual and anatomical healing. All surgeries were performed under local or general anesthesia by qualified vitreoretinal surgeons, utilizing a conventional 25-gauge pars plana vitrectomy system. The procedure consisted of removal of the vitreous opacities, relieving fibrovascular traction, and performing panretinal photocoagulation (PRP) that was done in turn with the primary procedure. In patients where there were advanced cataracts, a phacoemulsification with intraocular lens implantation (IOL) was performed as a routine of the operation. In some patients, preoperative intravitreal anti-VEGF injections were used to decrease the volume of bleeding intra-operatively and to decrease the risk of a post-operative hemorrhage. The primary outcome was the difference in best-corrected visual acuity (BCVA) which was measured in logMAR scores and analyzed 6 months after surgery. Secondary outcome measures were the defined anatomical success of having a clear vitreous cavity with an attached retina, along with the incidence of complications after surgery which included recurrent vitreous hemorrhage, a retinal detachment, or the need to undergo surgery again. Visual acuity before the operation was documented as well as best corrected visual acuity postoperatively assessed at one, three, and six months. Information regarding intraoperative and postoperative complications was also collected through structured follow-up visits.

Statistical Analysis: All data were analyzed using SPSS version 23. Quantitative variables such as age, duration of diabetes, and visual acuity were presented as mean ± standard deviation, while qualitative variables such as gender and complications were summarized as frequencies and percentages. The independent samples t-test was used to compare mean differences between groups, and the chi-square test was applied for categorical data. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Data were collected from 185 patients, mean age of patients was comparable between the two groups, 54.3 ± 8.7 years in the early group and 55.8 ± 9.2 years in the delayed group. Males comprised 58.7% of the early group and 61.3% of the delayed group. The mean duration of diabetes was 11.6 ± 4.2 years in the early group and 12.1 ± 4.6 years in the delayed group, indicating a similar disease profile. Most patients in both groups had type 2 diabetes mellitus (85.9% and 88.2%, respectively). Baseline best-corrected visual acuity (BCVA) was also similar across groups, with mean logMAR values of 1.88 ± 0.24 for early vitrectomy and 1.85 ± 0.27 for delayed vitrectomy.

The mean operative time was significantly shorter for early vitrectomy (64.2 ± 11.3 min) than for delayed vitrectomy (79.6 ± 14.7 min, $p < 0.001$). Intraoperative bleeding was less frequent in the early group (9.8%) compared to the delayed group (17.2%), though this difference was not statistically significant ($p = 0.09$). Combined cataract extraction was required in 23.9% of early cases and 31.2% of delayed cases ($p = 0.21$). Postoperatively, visual outcomes favored early surgery: mean BCVA at six months improved to 0.68 ± 0.19 logMAR in the early group versus 0.91 ± 0.23 logMAR in the delayed group ($p < 0.001$). Moreover, 66.3% of early vitrectomy patients achieved a vision of 6/18 or better, compared with 41.9% in the delayed group ($p = 0.002$).

Complete anatomical success, defined as retinal attachment with a clear vitreous cavity, was achieved in 97.8% of eyes in the early vitrectomy group and 91.4% in the delayed group ($p = 0.06$). Recurrent vitreous hemorrhage occurred significantly less frequently in early cases (10.9%) compared to delayed ones (22.6%, $p = 0.03$). Although retinal detachment was slightly more common in delayed vitrectomy (9.7%) than in early surgery (4.3%), this difference was not statistically significant ($p = 0.14$).

Both groups showed gradual enhancement in BCVA over time, but the improvement was more pronounced in patients undergoing early vitrectomy. At one month, the mean BCVA improved to 1.10 ± 0.21 logMAR in the early group versus 1.31 ± 0.26 logMAR in the delayed group ($p < 0.001$). By three months, the values improved further to 0.82 ± 0.20 and 1.04 ± 0.24 logMAR, respectively ($p < 0.001$). At six months, the early group achieved a final mean BCVA of 0.68 ± 0.19 logMAR compared to 0.91 ± 0.23 logMAR in the delayed group ($p < 0.001$).

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 185)

Variable	Early Vitrectomy (n = 92)	Delayed Vitrectomy (n = 93)
Mean age (years)	54.3 ± 8.7	55.8 ± 9.2
Gender (Male %)	54 (58.7%)	57 (61.3%)
Duration of diabetes (years)	11.6 ± 4.2	12.1 ± 4.6
Type 2 diabetes (%)	79 (85.9%)	82 (88.2%)
Baseline BCVA (logMAR)	1.88 ± 0.24	1.85 ± 0.27

Table 2: Intraoperative and Postoperative Visual Outcomes

Parameter	Early Vitrectomy (n = 92)	Delayed Vitrectomy (n = 93)	p-value
Mean operative time (min)	64.2 ± 11.3	79.6 ± 14.7	<0.001
Intraoperative bleeding	9 (9.8%)	16 (17.2%)	0.09
Combined cataract extraction	22 (23.9%)	29 (31.2%)	0.21
Pre-op BCVA (logMAR)	1.88 ± 0.24	1.85 ± 0.27	0.47
Post-op BCVA at 6 months (logMAR)	0.68 ± 0.19	0.91 ± 0.23	<0.001
≥ 6/18 vision at 6 months	61 (66.3%)	39 (41.9%)	0.002

Table 3: Anatomical Success and Postoperative Complications

Outcome	Early Vitrectomy (n = 92)	Delayed Vitrectomy (n = 93)	p-value
Anatomical success (attached retina + clear vitreous)	90 (97.8%)	85 (91.4%)	0.06
Recurrent vitreous hemorrhage	10 (10.9%)	21 (22.6%)	0.03
Retinal detachment	4 (4.3%)	9 (9.7%)	0.14
Re-operation required	3 (3.3%)	8 (8.6%)	0.11
Transient IOP rise	8 (8.7%)	12 (12.9%)	0.34
Neovascular glaucoma	2 (2.2%)	6 (6.5%)	0.18
Cataract progression (phakic eyes)	13 (14.1%)	19 (20.4%)	0.22

Table 4: Trend of Visual Acuity Improvement Over Time in Early vs. Delayed Vitrectomy Groups

Follow-up Interval	Early Vitrectomy (Mean BCVA ± SD, logMAR)	Delayed Vitrectomy (Mean BCVA ± SD, logMAR)	Mean Difference	p-value
Preoperative	1.88 ± 0.24	1.85 ± 0.27	0.03	0.47
1 Month	1.10 ± 0.21	1.31 ± 0.26	0.21	<0.001
3 Months	0.82 ± 0.20	1.04 ± 0.24	0.22	<0.001
6 Months	0.68 ± 0.19	0.91 ± 0.23	0.23	<0.001

DISCUSSION

The present study compared the visual and anatomical outcomes of early versus delayed pars plana vitrectomy (PPV) in patients with diabetic vitreous hemorrhage (VH). Out of a total of 185 patients, 92 patients had early vitrectomy surgeries within the first six weeks of the onset of their hemorrhages, while 93 had later surgeries. The study identified that these patients benefited from early vitrectomy due to better visual acuity outcomes, quicker visual recovery, and rates of recurrent vitreous hemorrhages that were lower than the patients who had delayed surgeries. Nonetheless, both early and delayed vitrectomy surgeries had similar rates of post-operative complication. In this study, the cohort of patients who had early postoperative penlight visual (PPV) surgeries had a mean BCVA logMAR (best corrected visual acuity) of 1.88 ± 0.24 and progressed to 0.68 ± 0.19 logMAR within the six-month follow-up, while the patients in the delayed cohort had pre-surgical BCVA logMAR of 1.85 ± 0.27 and had post-surgical BCVA logMAR improvement to 0.91 ± 0.23 logMAR. The promptness of surgery and visual benefits the patients received also mutually coincides with outcomes in previous studies. The reports have indicated that it was beneficial to the patients' vision to have the hemorrhage removed promptly, as it prevented the macula from undergoing rehabilitation and profused with dysfunctional photo receptores. The reports have indicated those visual outcomes were beneficial also to patients who underwent surgery within the first couple of weeks during the onset of the hemorrhages in contrast to patients who underwent surgery later interventions[14]. The Diabetic Retinopathy Vitrectomy Study (DRVS) was one of the early large multicenter trials that paved the way for the understanding of the potential benefits of early vitrectomy with excellent visual prognosis especially in the younger type 1 diabetic, but this was however, several decades ago, when the DRVS was implemented, and the surgical procedures were performed using large gauge instruments with longer operative times and higher complication rates. In contrast, the current study reflects modern vitreoretinal practice using 25-gauge and 27-gauge minimally invasive vitrectomy systems and wide-angle viewing combined with preoperative anti-VEGF that have all greatly reduced the amount of intraoperative bleeding and improved the outcomes of such procedures[15]. It is therefore likely that these technological advances contributed to the improved and safer outcomes observed with early vitrectomy in our study. In this study, the anatomical success stood at 97.8% in the early and 91.4% in the delayed cases, which is consistent with current series that report similar success and was high in both groups, but however, there was a relatively low occurrence of recurrent vitreous hemorrhage in the early group (10.9%) when compared to the delayed group (22.6%)[16]. The early removal of hemorrhagic vitreous is likely to reduce residual traction and possibly provide sufficient pan retinal photocoagulation during the procedure hence decreasing the neovascular activity and the chance of bleeding. Several works have underscored the benefits of early PRP to help attain a stable long-term outcome and reduce the risk of recurrent hemorrhage which adds support to the findings of the current work. The average time taken to complete the procedure was significantly shorter in the early vitrectomy group (64.2 ± 11.3 min) compared to the late vitrectomy group (79.6 ± 14.7 min) ($p < 0.001$)[17]. This difference has real clinical implications considering that the late cases often have more diffuse fibrovascular proliferation that requires extensive dissection and more time. Considering the above, early intervention in surgery leads to better improvement of postoperative vision. This also allows easier management of the case, and the fragile diabetic eye incurs less surgical toll, less surgical stress. Rates of retinal detachment, progression of cataract and neovascular glaucoma were however lower in the early group, but these were not statistically significant[18]. The early vitrectomy group had, however, fewer complications associated with early surgery and surgery in general. Delayed surgery contributes to the progression of traction and ischemic changes, which increases the probability of intraoperative tear and detachment in the retina postoperatively. Our data suggests that timely surgery delays the events above from happening, but these can only be confirmed with more advanced randomized control trials. This study was however limited to one tertiary center, which may limit generalizability. There was also no randomization done, which leads to selection bias. We also did not follow the patients for more than 6 months, which means no long-term outcomes including recurrence after 1 year were evaluated. Moreover, there is inconsistency regarding the collection of postoperative optical coherence tomography (OCT) and fluorescein angiography, both of which could have offered further structural correlation to the visual outcomes.

CONCLUSION

It is concluded that early pars plana vitrectomy in patients with diabetic vitreous hemorrhage results in better visual and anatomical outcomes compared to delayed surgery. Patients who underwent early vitrectomy achieved significantly greater improvement in best-corrected visual acuity, faster visual recovery, and lower rates of postoperative recurrent hemorrhage, while maintaining high anatomical success. Although both early and delayed interventions were effective in clearing the vitreous cavity and reattaching the retina, delayed surgery was associated with prolonged operative time and a higher frequency of postoperative complications. Early surgical intervention allows timely panretinal photocoagulation, minimizes fibrovascular proliferation, and enhances overall surgical ease and patient rehabilitation.

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