

# The Outcomes of Pars Plana Vitrectomy without Tamponade for Tractional Retinal Detachment Secondary to Diabetic Retinopathy

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## Abstract

**Objectives:** The objective of this research was to evaluate the outcomes of pars plana vitrectomy (PPV) without the use of an ocular tamponade in patients with tractional retinal detachment (TRD) secondary to proliferative diabetic retinopathy (PDR) presenting to Bahawal Victoria Hospital, Bahawalpur, Pakistan.

**Methods:** This was an interventional study conducted at the Department of Ophthalmology, Bahawal Victoria (B.V.) Hospital, Bahawalpur, Pakistan, from July 2011 to July 2012. A total of 75 patients (84 eyes) with TRD secondary to PDR were treated by PPV without using an ocular tamponade. All patients included in the study had a TRD secondary to PDR but did not have or develop retinal breaks before or during the study period. The surgical procedure included a PPV combined with the removal of the tractional retinal membranes and the application of endolaser photocoagulation to the retina. The mean follow-up period was 12 months.

**Results:** The study included 75 patients (84 eyes). Among these, 40 patients were females and 35 males. Successful retinal reattachment was observed in 78 of the operated eyes (92.8%). In these patients, the retina remained attached until the end of the 12 month follow-up period. Improvement in best corrected visual acuity (BCVA) was seen in 63 eyes (75%). The visual acuity remained unchanged in nine eyes (10.7%). Mean improvement in BCVA was  $2.00 \pm 1.24$  at baseline to  $1.24 \pm 1.22$  ( $P = 0.010$ ) at the end of the follow-up period.

**Conclusion:** In the absence of retinal breaks, a TRD secondary to PDR can be successfully treated and improved by PPV without the use of an ocular tamponade.

**Keywords:** endotamponade, pars plana vitrectomy, proliferative diabetic retinopathy, tractional retinal detachment

## Introduction

Diabetic retinopathy is a vascular retinal disease. Prolonged hyperglycemia in diabetes leads to the increased permeability and progressive occlusion of the retinal vessels. These alterations may lead to retinal lesions such as hard exudates, macular edema, soft exudates, and ischemia with visual impairment (1). Ischemia results in the production of angiogenic factors, development of neovascularization and the formation of fibro-vascular membranes. The fibrous element of a fibro-vascular complex may contract, causing the vitreous to induce traction on the retina. This can potentially result in a tractional detachment of the retina.

Proliferative diabetic retinopathy (PDR) with tractional retinal detachment (TRD) is therefore one of the most serious ocular complications of diabetes mellitus (1–3). Studies such as the

Early Treatment of Diabetic Retinopathy Study (ETDRS) and the Diabetic Retinopathy Study (DRS) have convincingly shown the benefits of panretinal laser photocoagulation (PRP) to reduce the risk of the development of PDR and TRD (4,5).

Once the PDR leads to TRD, especially involving the macula, the indicated treatment is often pars plana vitrectomy (PPV) with adjunctive procedures (3–6). A review of the literature does not clarify the issue of whether an ocular tamponade should or should not be used during PPV in an eye with TRD but without retinal breaks (3,6–14).

The idea that an endotamponade is not necessary in an eye with a TRD if the traction is relieved surgically without creating retinal breaks has been proposed previously. Going back to the

early days of vitrectomy surgery, several studies reported that ocular endotamponade was not necessary if retinal breaks were not present (10).

In 1980, a landmark study by Meredith et al. (10), described the membrane sectioning technique for diabetic vitrectomy, and the authors stated that there was no need to drain the subretinal fluid (SRF) if no breaks are present, because relief of traction is sufficient to allow reattachment of the retina. In an investigation published by Aaberg (11) in 1981, an intraocular gas tamponade was used in only 18 of 125 eyes with diabetic macular TRD. Rice et al. (12), in 1983, used an ocular gas endotamponade only in eyes with retinal breaks among 197 patients with diabetic TRD. In 1987, Thompson et al. (13) applied intraocular gas in only 67 of 301 eyes with diabetic TRD. In a group of eyes with diabetic TRD treated with the en-bloc technique, Williams et al. (14) did not use gas in 49% of the eyes.

Although the studies cited above reported the use of an ocular endotamponade, they did not focus on the question of whether or not an endotamponade is necessary if the retinal breaks are not present in an eye with TRD secondary to PDR. It is well-known that the best intervention will have the smallest number of complications, and when compared with PPV using a tamponade, vitrectomy without tamponade involves less risk of post-operative complications (such as oil/gas-related intraocular pressure increase and/or cataract).

We conducted this study to assess the outcomes of PPV without an ocular tamponade for the treatment of TRD secondary to PDR in patients presenting to the B.V. Hospital, Bahawalpur, Pakistan, from July 2011 to July 2012.

## Materials and Methods

This interventional study was conducted in the Ophthalmology Department of B. V. Hospital, Bahawalpur; Pakistan. Permission to conduct the study was received from the local ethical committee of this hospital in June 2011. First 75 patients presenting to the outpatient department of our hospital and fulfilling the inclusion criteria were enrolled in the study. Written informed consent was taken from all the patients before conducting the study. The research included eyes with diabetic TRD that were consecutively treated by PPV without an ocular endotamponade from July 2011 through July 2012. The patients in our study were operated on by an experienced vitreoretinal surgeon at the same institution.

The patients recruited for our study met the following inclusion criteria:

1. The patients had PDR with TRD;
2. No pre-existing retinal breaks and no iatrogenic retinal breaks during surgery were detected;
3. Intraocular tamponades (silicone oil/gas) were not used at the end of surgery; and
4. The follow-up period was at least 12 months.

The data were collected on standardised forms in a consecutive manner. Before surgery and at regular intervals after surgery, the patients underwent an ophthalmic examination, including BCVA measurement using a logarithmic visual acuity chart (log MAR chart), slit-lamp biomicroscopy of the anterior segment of the globe, tonometry, and ophthalmoscopy.

For eyes with opacities of the optic media preventing ophthalmoscopic assessment of the ocular fundus, a B-scan ultrasound examination was performed pre-operatively. However, the eventual diagnosis of TRD was based on the intraoperative findings. For those patients with relatively clear optic media before surgery, TRD was diagnosed during the pre-operative examination. The visual acuity measurements were converted into log MAR values for statistical analysis, and the calculation results were converted back into decimal values for this report.

All eyes underwent standard three port PPV using 20-gauge (20 G) instrumentation with a bimanual technique and using Binocular Indirect Ophthalmic Microscope (BIOM) system. Vitrectomy included removal of the posterior and peripheral vitreous body, induction of posterior vitreous detachment, and peeling of the fibrovascular epiretinal membranes from the retinal surface. PRP with up to 1000 laser coagulation spots was applied to all eyes included in the study. The number of intraoperative laser spots depended on the pre-operative laser status and the amount of attached retinal surface during surgery. During follow-up, with a gradual absorption of the SRF, laser coagulation was supplemented in the previously detached retinal areas. No intraoperative retinotomy to drain the SRF was performed, and the SRF remained untouched. As specified the inclusion criteria, there were no pre-existing or iatrogenic retinal defects during surgery.

Ocular endotamponades using silicone oil or gases were not employed, nor were intravitreal anti-neovascular drugs or steroids. We used modified lactated Ringer's solution as an irrigating

solution; this included 0.4% glucose, 16U/mL tobramycin, 0.0001% epinephrine, and 0.0016% dexamethasone.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, version 13). The data were presented as mean and standard deviation when appropriate. A paired sample t-test was performed whenever pre-operative data were compared with the post-operative measurements. A *P* value of less than 0.05 (2-sided) was considered statistically significant.

## Results

The study included 75 patients (84 eyes). Among these, 40 patients were females and 35 males (Table 1), with a mean age of 52 years (range 40–60 years). Of the 75 patients, 11 (14.7%) had insulin-dependent diabetes mellitus with a mean duration of 14.0 years (range, 20–36 years), and the remaining 64 patients (85.3%) had non-insulin dependent diabetes mellitus, treated by oral medication with a mean duration

of 11.0 years (range, 10–30 years). Of the 84 eyes, 5 (6.0%) were pseudophakic, 33 (39.2%) had cataract, and 46 (54.7%) had clear lenses (Table 2).

PRP had been performed before surgery in 40 eyes (47.6%). In 25 eyes (29.7%), severe vitreous hemorrhage was seen. Eleven eyes (13%) with severe vitreous hemorrhage, also had a macular TRD observed intra operatively; 24 eyes (28.5%) showed detachment of the macula without vitreous hemorrhage. Overall, the macula was detached in 35 eyes (42.8%). Twenty-four eyes (41.6%) exhibited non-macular TRD (Table 2). The PPV was combined with cataract surgery and intraocular lens implantation in 33 eyes (39.2%).

The pre-operative BCVA (log MAR) was  $2.00 \pm 1.24$  (Table 5). The mean follow-up was 12 months. The retina reattached in 78 eyes (92.8%) and remained attached until the end of the follow-up period in these eyes without any further surgical intervention. In six eyes (7.1%), the retina remained detached during the follow-up (Table 3). The visual acuity in these

**Table 1:** Demographic characteristics of patients

| Variable   | Male         | Female       | Total        |
|------------|--------------|--------------|--------------|
|            | <i>n</i> (%) | <i>n</i> (%) | <i>n</i> (%) |
| Sex        | 35 (46.6)    | 40 (53.3)    | 75 (100)     |
| Type of DM |              |              |              |
| IDDM       | 4 (36.3)     | 7 (63.6)     | 11 (100)     |
| NIDDM      | 24 (37.5)    | 40 (62.5)    | 64 (100)     |

Abbreviation: DM: Diabetes mellitus, IDDM: Insulin dependent diabetes mellitus, NIDDM: Non-Insulin dependent diabetes mellitus.

**Table 2:** Distribution of the eyes according to slit-lamp and ophthalmoscopic examination findings

| Examination findings             | Male         | Female       | Total        |
|----------------------------------|--------------|--------------|--------------|
|                                  | <i>n</i> (%) | <i>n</i> (%) | <i>n</i> (%) |
| Slit lamp examination findings   |              |              |              |
| Clear lens                       | 22 (47.8)    | 24 (52.1)    | 46 (100)     |
| Cataract                         | 13 (39.3)    | 20 (60.6)    | 33 (100)     |
| Pseudophakic                     | 2 (40.0)     | 3 (60.0)     | 5 (100)      |
| findings                         |              |              |              |
| Severe VH                        | 10 (40.0)    | 15 (60.0)    | 25 (100)     |
| Severe VH and macular detachment | 4 (36.3)     | 7 (63.6)     | 11 (100)     |
| Macular detachment without VH    | 10 (41.6)    | 14 (58.3)    | 24 (100)     |
| No macular detachment            | 9 (37.5)     | 15 (62.5)    | 24 (100)     |

VH: vitreous hemorrhage.

six eyes with continuing TRD ranged from no light perception (NLP) in one eye to 0.30 in one eye. In four of these six eyes, retinal holes in the mid-periphery or outer retinal periphery could be detected, which were treated by a second PPV with intraocular tamponade using 16% C2F6, 25% SF6, or silicone oil.

At the end of the follow-up, BCVA had improved in 63 eyes (75.0%), remained unchanged in nine eyes (10.7%), and worsened in twelve eyes (Table 4). The mean BCVA (log MAR) improved to  $1.24 \pm 1.22$  with a *P* value = 0.0010, which is statistically significant (Table 5). In two patients who did not consent to a second vitreoretinal intervention, for remaining retinal detachment, post-operative visual acuity was NLP. None of the eyes developed increased intraocular pressure.

### Discussion

In most of the eyes in our study, successful retinal reattachment was seen after PPV without ocular tamponade, and the retina remained attached throughout the follow-up period.

Consequently, the BCVA improved in 75% of the eyes and remained unchanged in 11%. From these findings, one may infer that if the retina is intact at the end of the peeling of epiretinal membranes, the operating surgeon may elect not to use an ocular endotamponade. This procedure avoids post-operative complications involving intravitreal gases such as a rise in intraocular pressure and pressure related optic nerve damage, reduced vision due to the intraocular gas bubble, and difficulties in observing the fundus during examination. It also avoids post-operative complications related to intravitreal silicone oil, such as oil induced hyperopia and anisometropia, silicone oil emulsification, secondary open-angle glaucoma, cataract development, and silicone oil displacement into the anterior chamber (1,3,6,14,16).

The surgical procedure adopted in our study is partially different from that used in some previous studies, in which intraocular silicone oil or intraocular gases were used almost routinely after PPV for severe TRD (4,17–19). We also suggest that intraoperative transretinal drainage

**Table 3:** Results of PPV in term of retinal re-attachment

| Status of retina                              | Male         | Female       | Total eyes   | <i>P</i> value |
|---|--------------|--------------|--------------|----------------|
|   | <i>n</i> (%) | <i>n</i> (%) | <i>n</i> (%) |                |
| Successful of retinal re-attachment after PPV | 38 (48.7)    | 40 (51.2)    | 78 (92.8)    |                |
| Retinal re-detachment after primary PPV       | 2 (33.3)     | 4 (66.6)     | 6 (7.1)      | 0.001          |

Abbreviation: PPV: pars plana vitrectomy.

**Table 4:** Visual status of eyes after pars plana vitrectomy

| Status of vision          | Male         | Female       | Total eyes   | <i>P</i> value |
|---------------------------|--------------|--------------|--------------|----------------|
|                           | <i>n</i> (%) | <i>n</i> (%) | <i>n</i> (%) |                |
| Improvement of vision     | 23 (36.5)    | 40 (63.4)    | 63 (100)     |                |
| Vision remained unchanged | 2 (22.2)     | 7 (77.7)     | 9 (100)      | 0.05           |
| Worsening of vision       | 3 (25.0)     | 9 (75.0)     | 12 (100)     |                |

**Table 5:** Difference in pre- and post-operative visual acuity

|               | Pre-Operative   | At 12 months Follow-up | <i>P</i> value |
|---------------|-----------------|------------------------|----------------|
|               | Mean $\pm$ SD   | Mean $\pm$ SD          |                |
| Visual acuity | $2.00 \pm 1.24$ | $1.24 \pm 1.22$        | 0.001          |

SD: standard deviation.

of the subretinal fluid may not be necessary to reattach the retina in all eyes with a diabetic TRD. If the major epiretinal tractional membranes were removed or relieved during surgery, the subretinal fluid may absorb spontaneously, similar to the resorption of subretinal fluid in eyes with a rhegmatogenous retinal detachment in which the retinal break was sealed by an episcleral buckle (20).

Another observation made in our study was that patients with large pre-operative retinal tractional detachments involving all quadrants more often required second surgery either because of new retinal breaks or because of unresolved subretinal fluid. Fifty percent of all patients requiring second surgery belonged to this group of patients. This may suggest that a short acting intraocular gas such as 20% sulphur hexafluoride (SF6) could be used during primary surgery in these patients in order to reduce the possible necessity of a second surgery.

In our study, intravitreal bevacizumab was not used as a preparatory pre-operative step to reduce the risk of intraoperative bleeding and thus to improve the intraoperative conditions for the surgeon. One may speculate that pre-operative bevacizumab or the pre-operative use of any other antivascular endothelial growth factor drug may have increased the rate of post-operative retinal detachment in the group of patients with a pre-operative four-quadrant TRD. Potential limitations inherent in our study should also be mentioned. The most important limiting factor was the design of the study, as it was an interventional study with no control group. A higher level of scientific evidence could have been achieved if a (randomised) comparative study had been performed with two groups of patients, one group receiving and the other not receiving an intraocular tamponade.

However, to plan and design such a study, it is necessary justify performing such an investigation using data on patients not receiving an intraocular tamponade. In view of the relatively small number of patients included in our study and the homogenous structure of the surgeon group, the findings of our study may, therefore, form a basis to perform such a randomised trial.

Another limitation of our study is that optical coherence tomography (OCT) was not performed to examine whether or not the subretinal fluid absorbed after the initial surgical procedure. The absorption of the subretinal fluid was assessed using ophthalmoscopic and

sonographic examination. One cannot exclude the possibility that in some patients, residual shallow submacular fluid remained undetected causing a delay in visual recovery.

## Conclusion

In our study, improvement in retinal reattachment was seen after PPV without ocular tamponade, and the retina remained attached throughout the follow-up period in our hospital setting. Therefore we recommend that in the absence of retinal breaks, TRD secondary to PDR can be successfully treated by PPV without the use of an ocular tamponade.

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## Conflict of Interest

None.

## Fund(s)

None.

## Authors' Contributions

Conception and design, analysis and interpretation of the data, drafting of the article: MIS

Critical revision of the article for the important intellectual content: RMRQ, MIS

Final approval of the article, statistical expertise: MFS

Provision of study materials or patient: RMRQ

Administrative, technical or logistic support: RMRQ, MFS

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