Pars Plana Vitrectomy for Resistant Cystoid Macular Edema

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ABSTRACT

Objective: To evaluate the results of pars plana vitrectomy for cystoid macular edema (CME) resistant to medical treatment.

Study Design: Quasi-experimental study

Place and Duration of Study: Al-Shifa Trust Eye Hospital, Rawalpindi, from January to July 2019.

Methodology: This study recruited 30 eyes of 30 patients with cystoid macular edema confirmed on optical coherence tomography that was refractory to medical treatment. Eyes with diabetic fibrous proliferation, optic atrophy, neo-vascular glaucoma, membrane and macular retinal pigment epithelial atrophy were excluded from the study. All patients underwent 23 G pars plana vitrectomy followed by epiretinal membrane / internal limiting membrane (ERM/ILM) peeling and gas injection. In 11 eyes, perfluoropropane gas was injected; while in 19 eyes, sulfurhexafluoride gas was injected. Main outcome measures included pre- and post-op Snellen's visual acuity and central macular thickness (CMT). All patients completed their follow-up of six months.

Results: Mean age of 16 male and 14 female patients was 54.30 ± 3.70 years. Postoperative Snellen's visual acuity improved to 0.61 ± 0.08 from 0.11 ± 0.04 and postoperative central macular thickness improved to $223.80 \pm 40.20 \mu\text{m}$ from $578.00 \pm 26.57 \mu\text{m}$. Both differences were statistically significant ($p < 0.001$).

Conclusion: Pars plana vitrectomy with ERM / ILM peel and gas injection for CME refractory to medical treatment is an effective treatment. There was significantly improved best corrected visual acuity (BCVA) postoperatively along with decreased CMT on optical coherence tomography (OCT).

Key Words: Cystoid macular edema, Pars plana vitrectomy, Optical coherence tomography.

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INTRODUCTION

Cystoid macular edema (CME) is one of the prime causes of vision loss due to retinal vascular disease. It is an increase in the thickness of the macula due to a disturbance of the blood-retinal barrier causing fluid accumulation mainly in the outer plexiform layer (OPL). Specifically, vitreo-macular traction (VMT) is frequently found to result in CME. Traction at the Muller cells causes strain and the blood retinal barrier collapses resulting in dissociation of retina and RPE, consequently leakage and edema.¹

Common causes of CME are diabetes, pars plana uveitis, retinitis pigmentosa, Irvine gas syndrome, laser photocoagulation, intraocular pressure lowering procedures, and certain drugs like prostaglandin E2 analogues.² Most cases resolve within four months. If CME persist longer than that, then intervention is required. Medical treatment includes use of non-steroidal anti-inflammatory drugs, corticosteroids, carbonic anhydrase inhibitors, anti-

vascular endothelial growth factors and chemical vitreolysis agents.³

Despite pharmacotherapy, a high number of patients continue to have persistent CME, which is considered resistant. An alternative option is pars plana vitrectomy (PPV) and removal of the posterior hyaloid as it decreases macular edema by relieving VMT.⁴

The present study was conducted to evaluate the surgical outcomes of pars plana vitrectomy with ILM / ERM peel and gas injection in terms of Snellen's chart visual acuity and OCT-based central macular thickness, respectively.

METHODOLOGY

This was a quasi-experimental study conducted at the Vitreo-Retina Department, Al-Shifa Trust Eye Hospital, Rawalpindi, from January to July 2019. Ethical approval was taken from the Institute's Research Ethical Committee (REC). Informed consents were taken from all the patients included in this study. Thirty eyes of 30 patients were included in the study. The sample size was calculated using the University of California San Francisco (UCSF) Clinical & Translational Science Institute paired T-test (before-after study) sample size calculator.⁵ Threshold for type 1 error (alpha) was kept at 0.05, for type II error (beta) the rate was 0.20, effect size was kept at 0.1; while standard deviation in the outcome (visual acuity

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outcome at 6 months) was taken as 0.17 from published literature.⁶ The calculated sample size was 23. One eye of patients 18 years or older with central macular thickness greater than 300 micrometers (μm) which was refractory to medical treatment were included in the study. Refractory to medical treatment was defined as a persistent central macular thickness of 300 μm or more after 3 intra-vitreous injections of bevacizumab spaced 4 weeks apart and subsequent one intra-vitreous injection of triamcinolone acetate. Eyes with neo-vascular glaucoma, optic atrophy, proliferative diabetic retinopathy with fibrous band proliferation threatening to cause a traction macular detachment and retinal pigment epithelium disturbances in macular region were excluded from the study.

After concise history, detailed ophthalmic evaluation was performed which included visual acuity examination (both unaided and best corrected), visual field examination by confrontation method, pupillary examination to rule out relative afferent pupillary defect (RAPD), Amsler grid test, anterior segment examination through slit lamp for any signs of uveitis and cataract, intraocular pressure measurement by Goldman applanation tonometer. Fundus examination was done by using 66 D high magnification lens and 90 D super-field lens for the vitreous cells, posterior hyaloids phase, epiretinal membrane formation, macular thickening, vitreous traction, posterior uveitis signs like vascular sheathing, and signs of diabetic retinopathy. The patients were examined through indirect ophthalmoscopy using 20 D lens to rule out peripheral breaks and snow ball opacities and areas of vitreous traction. The patients were thoroughly investigated by performing OCT macula and wide field imaging to assess the central macular thickness and thickening of the epiretinal membrane. The patients were thoroughly counselled regarding the refractive nature of their disease and possible surgical treatment.

23-G PPV with ERM/ILM peel with gas injection was performed. In 11 eyes, perfluoropropane (C3F8) was injected; whereas sulfurhexafluoride (SF6) was injected in 19 eyes. Six-month follow-up was maintained with BCVA and CMT and was noted on subsequent follow-ups.

Patient's age, gender, best corrected pre- and post-operative Snellen's visual acuity, pre- and post-operative OCT-based macular thickness and cause of CME were entered into the database. Patient's age, pre- and post-operative Snellen's visual acuity (in decimal notation) as well as macular thickness were reported as mean with standard deviation. Patient's gender was reported as frequency and percentage. All post-operative data was obtained at 6-month follow-up. Paired sample t-test was used to ascertain a statically significant change in post-operative visual acuity as well as macular thickness. A p-value of ≤ 0.05 was taken to be statistically significant.

RESULTS

A total of 30 eyes of 30 patients were included in the study ($n = 30$). Of these, 16 eyes were that of male patients (53.3%); while 14 eyes were of female patients (46.7%). All eyes were pseudophakic. The mean age of patients was 54.3 ± 3.70 years. Fifteen eyes had CME secondary to diabetic retinopathy, 10 had CME secondary to Uveitis; while two patients had Irvine-Gass syndrome and three developed CME after retinal cryopexy. The best corrected mean Snellen's pre-operative visual acuity was 0.11 ± 0.04 ; while mean pre-operative central macular thickness was $578.00 \pm 26.57 \mu\text{m}$. The mean best corrected Snellen's postoperative visual acuity improved to 0.61 ± 0.08 and mean post-operative central macular thickness reduced to $223.80 \pm 40.20 \mu\text{m}$. All postoperative data were collected at end of 6-month follow-up. This information is depicted in Table I.

Table I: Pre- and post-operative visual acuity and central macular thickness comparisons.

Parameter	Mean $\pm$ SD	Significance
Preoperative best corrected Snellen's visual acuity (decimal notation)	0.11 ± 0.04	$p = 0.000$
Postoperative best corrected Snellen's visual acuity (decimal notation) at 6 months	0.61 ± 0.08	
Preoperative central macular thickness	$578.00 \pm 26.57 \mu\text{m}$	$p = 0.000$
Postoperative central macular thickness at 6 months	$223.80 \pm 40.20 \mu\text{m}$	

There was a statistically significant difference between best corrected mean pre- and postoperative Snellen's visual acuity ($p < 0.001$). Similarly, there was a statistically significant difference ($p < 0.001$) between preoperative CMT and postoperative CMT.

DISCUSSION

CME is a complication that develops as a result of various diseases affecting the inner or outer blood retina barrier. Disturbance of the retinal capillaries comprising the blood retina barrier, leakage of fluid in retina, along with posterior hyaloid traction are responsible for CME formation.⁷

The ILM serves as a platform for aggregating astrocytes.⁸ Peeling it not only absolves the traction, but also inhibits the fibrous astrocytes from reaccumulating on the retina.⁹

Lewis *et al.* reported that vitrectomy was effective for treating diabetic macular edema with a taut posterior hyaloid unresponsive to laser treatment. Nine eyes with diabetic CME underwent vitrectomy 3 to 35 months (mean=12 months) before ILM removal. Resolution of the CME was not attained after the first vitreous surgery in any of these cases. Subsequently, ILM was removed. In all the nine eyes, CME resolved after ILM removal, and visual acuity improved.

Regarding improvement of visual acuity, eyes that underwent initial combined vitrectomy and ILM peel had

better visual outcomes, 8 of 12 achieved a visual acuity of better than 20/50 than did eyes that had previous vitrectomy without ILM peel.¹⁰ A similar observation was reported by Harbour *et al.*¹¹ A shorter interval from the onset of CME to vitrectomy and ILM removal resulted in marked improvement in visual acuity.

Gandorfer *et al.* removed the ILM in 10 eyes that initially underwent vitrectomy and two that had previous vitrectomy; and Stefaniotou *et al.* performed initial vitrectomy and ILM removal on 55 eyes. Visual acuity improved in 11 eyes (92%) and 38 eyes (69%), respectively; and macular edema resolved in all eyes and 43 eyes (78%), respectively, as seen by fluorescein angiography or biomicroscopy.^{12,13} However, these investigators did not analyse OCT findings. The detailed anatomic status of the macular edema was not available.

CME is also one of the important complications of uveitis and has a tendency to persist despite satisfactory control of the uveitis.^{14,15} A randomised pilot study (23 eyes) showed that PPV was more advantageous in terms of visual acuity and angiographic findings compared to a weaker effect of systemic treatment with steroids and immunosuppressants. However, the effect of ILM peeling was not assessed in uveitis.^{16,17}

VMT syndrome occurs when an incomplete posterior vitreous detachment leads to a lingering traction of the vitreous at the macula, resulting in CME. In a review to estimate efficacy of PPV for VMT, approximately one-third out of 259 eyes gained 2 Snellen's lines. Eyes gained an average 0.25 logMAR, which approximates to just less than 2 Snellen's lines.¹⁸

The results of this study were very similar, and all studies suggest the efficacy of ILM removal in the treatment of diabetic macular edema. To our knowledge, this is the first local report showing prompt resolution of CME in eyes that had undergone previous vitrectomy. Our study is limited by short-term follow-up and the lack of a control group; hence, the beneficial effect of PPV could not be compared with the natural disease course. Particularly, we could not exclude the effect of vitrectomy itself in assessing clinical results, as we did not perform the comparison with patients who received vitrectomy without ILM peel. Variability among disease subjects and their specific preoperative management (ocular medications received) was also not considered.

CONCLUSION

PPV with ILM / ERM peel and gas injection for CMO-resistant to medical treatment is a safe effective surgical procedure with favourable results, in terms of improvement in BCVA and decrease in macular thickness as documented by Snellen's visual acuity chart and OCT, respectively; thus, improving visual quality of life.

ETHICAL APPROVAL:

The approval for the study was taken from Ethical Review Committee of Al-Shifa Trust Eye Hospital, Rawalpindi prior to start of research (Reference No: ERC-30/AST-18).

PATIENTS' CONSENT:

Informed consents were taken from all patients prior to enrollment in the study.

CONFLICT OF INTEREST:

Authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

FAK: Conceived and designed study; collected, analysed and interpreted data; drafted manuscript.

NAQ: Planned and designed the work; data acquisition; revised it critically for important intellectual content; reviewed final draft.

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