Comparison of Phacovitrectomy with Pars Plana Vitrectomy Alone in Rhegmatogenous Retinal Detachment in Presbyopic Patients

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ABSTRACT

Purpose: To compare the outcome of pars plana vitrectomy (PPV) alone and combined with phacoemulsification (phacovitrectomy) in eyes with rhegmatogenous retinal detachment (RRD) and any degree of accompanying lens opacity.

Materials and Methods: Medical charts of patients who underwent PPV with or without phacoemulsification were retrospectively reviewed. Eyes were recruited in Group A in case phacoemulsification was not performed (n=66) and in Group B in case they underwent phacovitrectomy (n=36). Patients under the age of 40 were excluded. Demographic and baseline clinical features, anatomical and functional outcome as well as complications were compared. The primary outcome measure was anatomical and functional success following silicone oil removal.

Results: The groups were similar in terms of number of retinal breaks, detached retinal quadrants in clock hours and macular status. Phacovitrectomy caused significantly higher fibrin reaction (p=0.007) and high intraocular pressure (p<0.005) that responded to medication in the postoperative course. In Group A, the lens opacity progressed in 47 eyes. Primary outcome measure was achieved in 38 patients in Group A and 19 patients in Group B (p=0.7).

Conclusion: Simultaneous cataract surgery did not alter the outcome in eyes with RRD associated with any degree of cataract in presbyopic patients. The clinical outcome was similar with minor complications in both groups.

Keywords: cataract, rhegmatogenous retinal detachment, phacovitrectomy, phacoemulsification, pars plana vitrectomy.

INTRODUCTION

Cataract development is a consequence of aging. Vitreous syneresis and synchesis due to normal aging process could increase the risk of retinal break formation, even leading to rhegmatogenous retinal detachment (RRD). Currently, with the development in instrumentation and fluidics, surgical trend moves toward pars plana vitrectomy (PPV) in RRD.[1]

Coexistence of cataract and various vitreoretinal disorders is not an uncommon situation particularly in the elderly.[2] Dense cataracts obscure visualization of the fundus during surgery. As the lens thickens with age, this could limit thorough vitreous base shaving, which has utmost importance particularly in cases with proliferative vitreoretinopathy (PVR). There is a risk of touching the lens with the vitreoretinal instruments even with a clear lens. On the other hand, PPV itself is known to induce cataract progression in phakic eyes.[3] Yet, cataract surgery might be challenging in previously vitrectomized eyes.[4]

Allowing quick visual recovery and avoiding the aforementioned issues, simultaneous removal of the lens together with vitreoretinal surgery seems to be a proper option in cases with coexisting cataract and RRD. Perhaps, the outcome of combined procedure is limited by some intra and post-operative complications like prolonged surgical duration and increased inflammation. Up to date, the results of combined phacoemulsification and pars plana vitrectomy (PPV) have been evaluated by numerous reports; increased anterior chamber reaction with fibrin deposition, posterior synechia formation, and elevated intraocular pressure (IOP) were commonly reported in the

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literature.[5-15] Combination procedure allows faster recovery, thus enhanced cost-effectivity. A second surgery is avoided and could be said to be an "all in one" procedure.[5,16,17]

Pars plana vitrectomy was reported to be associated with lower success rates in RRD in phakic eyes compared to eyes with removed crystalline lens.[8,18-21] In PPV for RRD, as thorough vitreous base removal is particularly required for improved outcome. Hence, it would be appropriate to evaluate the effect of lens removal on surgical success. Up to date, no "gold standard" treatment has been established in cases of RRD coexisting with any degree of cataract. In this current study, we aimed to compare the results of PPV alone with combined phacoemulsification and PPV (phacovitrectomy) in our patients with RRD.

MATERIALS AND METHODS

Study Design

We retrospectively reviewed the clinical records of consecutive patients who underwent PPV with or without phacoemulsification for RRD between November 2014 and September 2018 at Cukurova University, School of Medicine, Department of Ophthalmology. The research adhered to the tenets of Declaration of Helsinki. Patients were operated following brief information on the benefits and risks of the procedure; a signed informed consent was obtained from all patients prior to surgery. This study was approved by the Board of Clinical Research and Ethics of Cukurova University (14 June 2018, 89/18). All methods were performed in accordance with the relevant guidelines and regulations.

Patients

An anonymized research was undertaken. All patients underwent primary PPV for RRD. The cataract significance was graded by the surgeon; thus, the decision to do cataract surgery depended on the surgeon's preference. Patients having PPV alone comprised Group A and patients having phacovitrectomy comprised Group B.

Patient demographics, change in visual acuity (VA) and IOP; data regarding fundus findings like number of retinal breaks, retinal quadrants detached, macular status, presence of unnoticed retinal breaks; intraoperative data as well as peroperative and postoperative complications, and anatomical outcome were assessed. All patients underwent comprehensive ophthalmological examination at all visits. Snellen VA was recorded first and then converted to logarithm of the minimal angle of resolution (logMAR) for statistical analysis. The IOP measurements were made with Goldmann's applanation tonometer.

The intraocular lens power was calculated using the SRK-T formula. In case the vitreoretinal pathology did not allow accurate measurements, the fellow eye was measured.

All patients were evaluated prior to surgery and at the 1st day, 1st week, 1st month of the operation and additionally when necessary. Only presbyopic patients (aged over 40) were included. All patients were followed up for at least 6 months. Patients with missing clinical or surgical data; traumatic cases; eyes with giant retinal tear or PVR of worse than CP1;[22] cases which were left aphakic at the end of the combination surgery for any reason, and patients who were treated by scleral buckling associated with PPV were excluded. Due to the small number, eyes in which gas was used as tamponade were also excluded to avoid a potential interference in the results.

The primary outcome measure was anatomical (fully attached retina) and functional (increased VA compared to baseline) success following silicone oil removal. We also analyzed the change in visual acuity, as well as the reattachment rate of the retina. Peroperative and postoperative complications were assessed in both groups.

Surgical procedure

All procedures were performed by three experienced surgeons (SS, EE & ND) under general anesthesia. In all cases 23-gauge 3-port PPV was performed with the Eva vitrectomy system (DORC Inc, Zuidland, The Netherlands). A non-contact wide-angle viewing system was used (Resight 500, Carl Zeiss Meditec AG, Jena, Germany).

First, a 23-gauge one-step valved trocar was placed in the temporal or lower temporal quadrant 4 mm behind the limbus. In Group B, this was followed by a routine phacoemulsification procedure, with two horizontal meridian side-port incisions and a 2,75 mm clear corneal incision at the superior quadrant. The anterior chamber was filled with sodium hyaluronate 1.6%, a 5.5 mm in diameter continuous curvilinear capsulorhexis was created with Utrata forceps; following hydrodissection and hydrodelineation phacoemulsification with nucleus chopping and irrigation/aspiration of the lens cortex was performed. Single-piece hydrophobic acrylic IOL (AcrySof SA60AT; Alcon Inc, Fort Worth, TX) was implanted in the capsular bag. After the IOL implantation, the anterior chamber was left filled with ophthalmic viscosurgical device. The side-port incision was closed with stromal hydration and the clear corneal incision was sutured with a 10-0 nylon stich with buried knots. This was followed by the placement of at least 2 trocars (a 3rd one was placed in case a chandelier light was needed) in the upper nasal

and upper temporal quadrants 3.5 mm behind the limbus. The vitreoretinal surgery was performed sequentially. At the end, the ophthalmic viscosurgical device in the anterior chamber was washed out.[5,8,18]

The PPV was common in both groups. Following the placement of the trocars, first core vitrectomy, then peripheral vitreous shaving was performed. Care was taken to remove the peripheral vitreous thoroughly by the aid of scleral depression. Then the retina was flattened with perfluorocarbon liquid (PFCL) (Eftiar.05. DEC, DORC Inc, Zuidland, The Netherlands) letting the subretinal liquid drain through the retinal break. Epiretinal bands, if any, were removed. In case, the retina did not reattach despite PFCL, a drainage retinotomy was made. Laser retinopexy was applied around the breaks under PFCL and a PFCL-silicone oil (SO) (either 1000 or 5000 centistokes) (SIL 1000/5000, DORC Inc, Zuidland, The Netherlands) change was performed. By the end of the procedure, the trocars were removed and the sclerotomy incisions were sutured transconjunctivally with 7-0 polyglactin. The water-tightness of all incisions were checked. A subconjunctival injection of dexamethasone and cefuroxime was administered.

Patients were instructed to maintain prone positioning for 24 hour following surgery. In the postoperative period the patients were prescribed moxifloxacin drops 5 times daily for 10 days, prednisolone acetate 1% drops hourly which was tapered after 1 week till the 1st month of the surgery. In combination cases, tropicamide 1% BID was administered for at least a week. In case of severe anterior segment inflammation subconjunctival dexamethasone was injected daily until the findings subsided.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics Version 20.0 statistical software package (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0., Armonk, NY). Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as mean and standard deviation and as median and minimum-maximum where appropriate. Chi-square test was used to compare categorical variables between the groups. For comparison of continuous variables between two groups, the Student's t-test or Mann-Whitney U test was used depending on whether the statistical hypotheses were fulfilled or not. For comparison of two related (paired) continuous variables, paired samples t-test or Wilcoxon Signed Rank test was used depending on whether the statistical hypotheses were fulfilled or not. The statistical level of significance for all tests was considered to be 0.05.

RESULTS

Demographic and Preoperative Data

Medical charts of 212 patients were reviewed and 102 eyes of 102 patients were enrolled. Group A comprised 66 patients with an average age of 54.3±10.4 (41-74) and Group B comprised 36 patients with an average age of 62.3±9.9 (42-82) ($p<0.001$). There was no significant difference between groups A and B by gender (51 males and 15 females vs. 28 males and 8 females, respectively; $p=0.9$). The laterality either, did not differ significantly (R/L were 46/20 vs. 19/17, respectively; $p=0.08$). The duration from the beginning of symptoms to the operation was 4.4±3.0 (1-30) weeks in Group A and 3.0±1.9 (1-8) weeks in Group B ($p=0.048$). The mean duration of follow-up was 10.4±2.2 months (6-48 months). The mean duration of follow-up in Groups A and B are 23.4±14.9 months (6-77months) and 17.3±13.3 months (6-40 months).

The number of preoperative detected breaks were 1.4±1.0 (0-4) in Group A and 1.3±0.8 (0-3) in Group B. The extent of RD in clock hours were 7.0±2.9 (2-12) in Group A and 7.8±3.4 (2-12) in Group B. There were 58 (87.9%) macula off detachments in Group A and (97.2%) in Group B ($p=0.1$).

Perioperative Data

Additional retinal breaks which were undiagnosed at presentation were detected during operation in 34 (51.5%) eyes in Group A and 21 (58.3%) eyes in Group B ($p=0.5$). A drainage retinotomy was required in 8 (12.1%) patients in Group A and 11 (30.6%) patients in Group B ($p=0.005$). In both groups iatrogenic retinotomy occurred during vitreous base shaving in 4 (6.1%) and 5 (13.9%) patients in Groups A and B respectively ($p=0.18$).

Intraoperative miosis occurred in 29 (80.6%) patients in Group B; all cases responded to intracameral epinephrine (0.001%). There was no need of pupil expander devices; no cases of capsular rupture occurred in Group B. No intraoperative miosis occurred in Group A; no case of lens touch was encountered as well.

Postoperative Data

The comparison of VA (baseline and postoperative) between groups is given in Table 1. At the last visit following SO removal, the groups did not significantly differ by means of VA (1.1±0.83 [3.1-0] in 47 eyes in Group A vs. 0.83±0.62 [3.1-0.15] in 22 eyes in Group B; $p=0.14$).

The groups were not different by means of preoperative IOP (12.5±2.9 mm Hg [7-22] vs. 12.7±3.6 mm Hg [7-22], respectively [$p=0.74$]). Baseline and postoperative IOP

Table 1: *Baseline and postoperative visual acuity scores (logMAR) in both groups.*

	Group A	Group B	p
Baseline	2.0±1.03 (3.1-0)	2.3±1.0 (3.1-0.1)	0.12
1st month	1.2±0.6 (3.1-0.4)	1.1±0.6 (3.1-0.5)	0.02
3rd month	0.6±0.7 (3.1-0.0)	0.5±0.7 (3.1-0.0)	0.3

measurements are given in Table 2. Following surgery, 38 (57.6%) patients in Group A and 16 (44.4%) patients in Group B required antiglaucoma medication (p=0.2). At the postoperative first day, significantly higher number of patients had IOP of over 22 mm Hg in Group B (6 vs. 12, p<0.005). The comparison of groups by means of high IOP course despite medication are given in Table 3.

Fibrin reaction at the anterior chamber was evident in one (1.5%) patient in Group A, whereas 6 (16.7%) patients revealed fibrin reaction in Group B at the postoperative first day (p=0.007). All cases responded to subconjunctival steroid injections and resolved completely.

In the early postoperative period incision leak or IOL capture were not encountered in any patient. No cases of postoperative endophthalmitis occurred. In Group B, posterior synechia developed in 2 (5.6%) eyes.

No significant posterior capsular opacification was observed throughout follow-up.

There were no cases of persistent hypotonia (IOP under 5 mm Hg) in both groups.

Successful retinal reattachment - totally attached retina under SO - was achieved with pars plana vitrectomy in 55 (83.3%) eyes in Group A and in 27 (75.0%) in Group B (p=0.3). In Table 4, the groups were compared due to the preoperative and postoperative factors that might affect retinal reattachment. In 55 (83.3%) cases in Group A, any degree of cataract developed and in 47 (71.2%) cases SO removal was combined with phacoemulsification. Silicone oil was removed in 10.9±6.3 (4-36) vs. 7.6±4.6 (3-23) months in Groups A and B respectively (p=0.033).

Forty-seven eyes in Group A and 22 eyes in Group B underwent SO removal. Primary outcome measure (completely attached retina 6 months following SO removal) was achieved in 38 (80.9%) patients in Group A and 19 (86.4%) patients in Group B (p=0.7). Table 5 reveals the comparison between groups based on the

Table 2. *Postoperative (till month 3 post-PPV) intraocular pressure (mm Hg) comparison between groups.*

	Group A	Group B	p
1st day	15.6±6.1 (4-34)	22.0±10.9 (8-51)	0.002
1st week	19.1±8.1 (10-43)	15.2±6.5 (6-31)	0.016
1st month	18.1±7.2 (9-50)	14.1±3.8 (8-30)	0.02
3rd month	16.3±5.1 (10-45)	16.2±5.2 (12-38)	0.19

Table 3: *Comparison of groups due to eyes with high intraocular pressure readings despite medication following primary surgery and silicone oil (SO) removal.*

		Group A (n)	Group B (n)	p
Following primary surgery	**1st day**	6	12	<0.005
	1st week	18	6	0.57
	1st month	10	2	0.42
	3rd month	5	4	0.49
	Last visit	4	2	0.20
Following SO removal	**1st day**	2	0	0.57
	1st week	5	1	0.34
	1st month	3	2	0.08
	3rd month	1	1	0.12
	Last visit	3	2	0.23

Table 4: *Comparison of groups due to the preoperative and postoperative factors that might affect retinal reattachment (55 eyes in Group A, 27 eyes in Group B).*

	Group A	Group B	p
Preoperative macular detachment (macula off) [n (%) eyes]	48 (87.3)	26 (96.3)	0.6
Number of initially detected breaks [mean±st. dev (min-max)]	1.3±1.0 (0-4)	1.3±0.8 (0-3)	0.8
Extent of retinal detachment in clock hours [mean±st. dev (min-max)]	7.0±2.9 (2-12)	7.6±3.1 (3-12)	0.4
Additional retinal breaks which were undiagnosed initially [n (%) eyes]	33 (60%)	21 (77.8%)	0.5
Iatrogenic retinotomy [n (%) eyes]	3 (5.5%)	5 (18.5%)	0.6
Drainage retinotomy [n (%) eyes]	7 (12.7%)	8 (29.6%)	0.07

Table 5. *Comparison of groups due to the preoperative and postoperative factors that might affect retinal reattachment following SO removal (38 eyes in Group A, 19 eyes in Group B).*

	Group A	Group B	p
Preoperative macular detachment (macula off) [n (%) eyes]	33 (86.8)	18 (94.7)	0.62
Number of initially detected breaks [mean±st. dev (min-max)]	1.3±0.9 (0-4)	1.3±0.7 (0-3)	0.73
Extent of retinal detachment in clock hours [mean±st. dev (min-max)]	6.7±2.8 (2-12)	7.2±3.2 (3-12)	0.54
Iatrogenic retinotomy [n (%) eyes]	2 (5.3%)	3 (15.8%)	0.32
Drainage retinotomy [n (%) eyes]	5 (13.2%)	4 (21.1%)	0.43

preoperative and postoperative factors that might affect retinal reattachment following SO removal.

DISCUSSION

In this current study, we aimed to compare the long-term outcome and complications between pars plana vitrectomy alone and combined with phacoemulsification (phacovitrectomy) when necessary, in patients with RRD in the presbyopic era. Baseline clinical features of the patients in both groups were quite similar. Perioperative data regarding vitreoretinal procedures like iatrogenic break formation or detection of additional retinal breaks which could not be detected at initial presentation did not reveal significance. A drainage retinotomy to reattach the retina was significantly more required in the phacovitrectomy procedure. Other intraoperative complications were procedure-sensitive. Intraocular miosis, which did not occur in PPV alone, was a common complication of phacovitrectomy. Lens touch - an expected complication of PPV alone - was not encountered in any case. In terms of postoperative findings, phacovitrectomy cases revealed significantly higher rates of IOP rise at the first postoperative day and fibrin reaction in the anterior chamber. Visual outcome, IOP course and clinical course were similar between groups. Both groups reached the primary outcome measure following silicone oil removal without significant difference.

The patients undergoing phacovitrectomy (Group B) were significantly older. A recent study also reported a significantly higher age in the combined surgery group versus PPV only.[23] Perhaps, this should not be surprising as the incidence of cataract is subject to increase as the crystalline lens ages. We only included patients over 40 years old. This has a multilateral rationale. As these patients already suffer from lack of accommodation, removal of the crystalline lens did not make any sense in terms of near vision correction following surgery. With age, RRD homogenously tends to occur due to anomalous posterior vitreous detachment; thus, we were able to avoid traumatic cases or cases of RD due to congenital vitreoretinopathies, both of which would have a different outcome. Also, vitreoretinal surgery is known to be challenging due to the nonliquefied gelly structure of the vitreous in the young; this would have interfered with the results.[24]

The main rationale of phacovitrectomy in RRD is to provide enhanced vitreous base shaving and maintain a nearly-complete vitreous removal. This has utmost importance for retinal reattachment.[25] Other advantages could be listed: faster visual recovery, enhanced visualization of the peripheral fundus, avoidance of postvitrectomy cataract which is almost inevitable and associated with several complications. On the other hand, its main disadvantage is increased postoperative inflammation, as well as slight increase in PVR.[26]

Caiado and co-workers analyzed the effect of lens status, also different tamponade agents (gas or SO) on the outcome of surgery for RRD. Their group were not significantly different by means of baseline clinical features. Phakic eyes were associated with a higher rate of retinal redetachment compared to non-phakic eyes; the authors hypothesized that this was due to the impossibility of complete vitreous removal in phakic eyes.[18]

In this current study, the perioperative and postoperative complications were comparable to previous reports. Likewise, postoperative complications like fibrin reaction and IOP rise resolved with adequate treatment.[8,23,26,27] In their group which comprised various vitreoretinal pathologies undergoing phacovitrectomy, Pollack and co-workers reported no capsular rupture, 11.9% mild fibrinous reaction, 23.8% rise of IOP at the postoperative first day, 9.5% posterior synechia.[27] The most common intraoperative complication we faced was intraoperative miosis (80.6%) which responded well to intracameral epinephrine. Tosi and associates reported the use of iris retractors due to sudden miosis in two cases.[8] Although we did not need to use iris retractors, the higher rate we found could be explained by "zero tolerance" to any degree of miosis to achieve better visualization of the peripheral

retina. We encountered posterior synechia in 2 (5.6%) patients in the combined group. A similar rate was reported in another study (6.2%).[13] We believe, the twice a day use of tropicamide eye drops - a short acting pupil dilator - helped us to maintain a low number of posterior synechia. Nevertheless, the high rate of intraoperative miosis in Group B, which was not naturally evident in Group A, might have supposedly resulted in an increase in the rate of early postoperative anterior chamber inflammation.

Smith and co-workers faced iatrogenic retinal break in 1 of their 92 patients, which was quite lower compared to ours. They reported a redetachment rate of 11.8% all due to PVR, without any missed breaks.[26] During follow-up, cataract surgery was required in 83.3% of eyes in PPV only group. This was in accordance with the outcome (78.4%) of a large series.[23] Tosi and associates reported comparable retinotomy rates in both groups (17.2% vs. 13.3%, p=0.731).[8] Posterior capsular opacification was reported to be increased following phacovitrectomy.[28] We believe, the hydrophobic nature and the edge design of the IOL we implanted helped us delay posterior capsular opacification.

With the comparable rates of complications, we achieved similar clinical outcomes in both groups. Both following PPV and following SO removal retinal reattachment rates did not differ significantly, as well as the similar visual acuity scores. Our success rates - percentage of eyes reaching primary outcome measure - (80.9% and 86.4%, Groups A and B respectively) were in accordance with the findings of previous reports.[8,18,23] Tan and co-workers reported comparable anatomic success with PPV only and phacovitrectomy.[23] On the other hand, in another report, combined surgery was associated with a significantly higher retinal redetachment (26.2% vs. 12.7%); however, there were 126 patients in the phacovitrectomy group (versus 1564).[29] Perhaps, the unbalanced number of patients in both groups makes the comparison challenging. On the other hand, the authors of this manuscript stressed that the higher rates of inflammation caused by combined surgery, might have played a role in the reported higher rates of failure.

There are several limitations to be acknowledged regarding our manuscript. First of all is the retrospective design. Moreover, our group comprised a relatively small number. Yet, this number is still comparable with previous reports. Another limitation is that, the choice of surgical procedure was based on the surgeon's preference. Although all three surgeons were highly experienced, this could still have resulted in bias somehow; the surgeon might have tended to decide to remove the lens in more severe cases. In all cases SO was used as the temporary tamponade, this could have resulted in a higher rate of cataract development in Group A by potentializing the cataractogenous effect of PPV. Yet, SO was reported to have a more favorable effect on retinal reattachment compared to gas tamponade.[18] We did not consider any potential effect of different density silicone oils (1000 or 5000 centistokes) on the outcome. This could be another limitation.

Our study is confined to a single vitreoretinal pathology and has a homogenous cohort. We believe this is the main strength of our manuscript. The baseline clinical features of both groups, particularly regarding retinal status, were quite similar, which we believe provided a more accurate comparison of perioperative and postoperative data.

In conclusion, both PPV alone and phacovitrectomy yielded similar outcome in the management of RRD in presbyopic patients. The clinical results and the complications were comparable. It should be kept in mind that, combined surgery is not totally devoid of complications, particularly increased intraocular inflammation, albeit rare. With the favorable outcome obtained with PPV alone, cataract surgery should be kept for significant cataracts only. Further studies with larger series and controlled design would help to confirm present findings.

DECLARATIONS

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Conflicts of interest: None of the authors declare conflicts of interest.

Ethics approval: This study was approved by the Board of Clinical Research and Ethics of Cukurova University (14 June 2018, 89/18). The tenets of the Declaration of Helsinki were followed.

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