23-Gauge vitrectomy for retinal detachment with upper and lower retinal breaks
A comparative study

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DOI: 10.31364/SCIRJ/v9.i01.2021.P0121837
http://dx.doi.org/10.31364/SCIRJ/v9.i01.2021.P0121837

Abstract-
Purpose: *To* compare the anatomic and visual outcomes of upper retinal break detachment and lower retinal break detachment after 23-gauge vitrectomy.

Methods: Fifty participants with retinal detachment were assigned and divided into two groups. Twenty patients with upper retinal break detachment were recruited into group A and 30 patients with lower retinal break detachment were recruited into group B. 23- Gauge vitrectomy and silicone oil removal were performed to all participants. The primary outcome measure was the failure rate, defined as the retina was detached in silicone filled eye or within 6 weeks after silicone removal. A range of secondary outcomes were determined, including risk factors like the retinal breaks location, laser applied around the breaks, and complications following retinal detachment surgery. The final visual acuity was assessed.

Results*:* The failure rate after 23-gauge vitrectomy was (15/50) 0.3; fifteen had recurrent detachment (3cases- group A, 12 cases group B) (P=.047). After two 23-gauge vitrectomy three had recurrent RD in group B (P=.083). More than two procedures did for three cases of group B. Proliferative vitreoretinopathy is the significant risk factor with weak clinical effect. The final visual acuity at 6 months after SO removal in all participants in both groups was not significant (P=.099). Survival analysis revealed that, the time onset of postoperative retinal detachment in the first 3-6 months after silicone oil removal has no statistical difference between both groups A and B (P=.404)

Conclusions*:* The first 23- Gauge vitrectomy has less failure rate in upper retinal break detachment compared with lower retinal break detachment. Proliferative vitreoretinopathy is the significant risk factor for recurrent RD. All participants have good visual acuity at 6 months after SO removal compared with the preoperative visual acuity.

Key Words: v*itrectomy-silicone- retina- breaks-proliferation-detachment –upper-lower.*

I. Introduction

23- Gauge pars plana vitrectomy (PPV) improves the visualization of the peripheral retina, the detection of small retinal breaks in the periphery and allowing complete vitreous removal in phakic and pseudophakic RD[1,2].
Inferior retinal breaks can be treated with 23-gauge vitrectomy without additional scleral buckle. The difficulty in inferior vitreous management in phakic ,pseudophakic eyes, the questionable direct tamponading effect, and the higher rate of redetachment after pars plana vitrectomy, are the problems of the procedure[3].
After 23 gauge vitrectomy, the patients lie erect or sit to keep the long contact between gas/silicone bubbles with the superior retinal breaks. The situation is complicated if we will do vitrectomy without buckling in inferior retinal breaks. We need nearly full gas/silicone bubble and special positioning[4].
In silicone filled eye, there is reproliferation under the bubble.This is may be harmful to the inferior retina especially if lower retinal breaks are present. The statement that, we don't need tamponade if all breaks are closed and there is no traction. This statement is questionable[5].
In this paper, we report the anatomic and visual outcomes after 23-gauge vitrectomy for upper retinal break detachment (group A) and lower retinal break detachment (group B).

http://dx.doi.org/10.31364/SCIRJ/v9.i01.2021.P0121837

II. Methods and Subjects

This was a prospective and randomized study. The study protocol was approved by the Ethics Committee of Ain Shams University (FWA 000017585 and FMASU R25/2017). The study was carried out in accordance with the tenets of the Declaration of Helsinki, and all participants provided written and informed consent to participate. Patients were included if they had upper or lower retinal breaks. These breaks were associated with RD, moderate degrees of proliferative vitreoretinopathy (PVR ≥ Grade-C). We were accepting cases with previous buckle surgery or pseudophakia. Patients were excluded if the retinal tear was giant, presence of intravitreal foreign body, previous vitrectomy done before, cases that need relaxing retinotomies or retinectomy or if follow-up data were unavailable for a minimum follow-up of 6 months following the final retinal procedure. All participants recruited and admitted to Ain Shams Specialized Hospital and eye centers between November 2011 and October 2015.

III. Randomization and Treatment

In this study, our intention was to identify surgical failures, risk factors, visual outcomes, intraoperative and postoperative complications in both groups A and B. All surgeries did by single surgeon. This minimized other confounding factors, such as surgical experience. To do this, we screened all participants, recruited those who met our specific inclusion criteria, and obtained written and informed consent to participate. Each of the recruited patients were assigned a study number and randomized in accordance with a simple block randomization scheme.

IV. Surgical procedures

23- Gauge vitrectomy was performed to all participants as previously described[6]. The surgical technique consisted of

- Removal of vitreous gel

-Induction of posterior vitreous detachment (PVD) was done (if posterior hyaloid face was still attached)

-Installation of heavy perfluorocarbon liquids

-Identification and marking of retinal breaks

-Internal drainage of subretinal fluid and Air infusion

-Laser treatment of retinal breaks

-Silicone oil (SO) injection

-Closure of sclerotomies and conjunctival closure

In group A, we removed the vitreous around the breaks thoroughly and apply laser at the edge of the break and three rows around the break.

In group B, we removed the vitreous around the break. Tano scraper was used to remove the epiretinal membranes and residual hyaloid face. Laser applied to the edge of the break, three rows around the break and extended to the ora serrata.

- Three –six months after 23- gauge vitrectomy, SO was removed in all participants.

V. Patient visits

After 3-6 months we removed the silicone and examined the retina for 6 months after surgery. Patients were followed-up for 6 months after 23gauge procedures and SO removal. At each follow-up visit, we analyzed a range of variables, including visual acuity, fundus examination, IOP, slit lamp examination, and the incidence of intraoperative and postoperative complications. We used B-scan to detect early recurrence in suspicious cases with hazy media. Early admission for second interference was done. All retinal redetachment operations were performed at the time of SO removal or after and silicone oil was injected again. The primary outcome measure was the failure rate, defined as the retina was detached in silicone filled eye or within 6 weeks after SO removal. A range of secondary outcomes were also determined, including risk factors like the retinal breaks location, laser applied around the breaks, and complications following RD surgery. The best visual acuity during the follow-up period and the final visual acuity were assessed.

VI. Statistical Analysis

Demographic data of the participants were estimated with Mann–Whitney, independent T-test and chi-square test of independence. Fifty participants with RD were assigned and divided into two groups. Twenty patients with upper retinal break detachment were recruited into group A and 30 patients with lower retinal break detachment were recruited into group B. General linear model with multivariate analysis was used to compare the risk factors in the two groups. Survival time of the retinal stability was calculated from the date of the operation to the date of retinal redetachment or last follow-up, and survival curves were constructed using the Kaplan–Meier method. The final retinal reattachment, best and final visual acuity were analyzed using the Pearson chi-squared test or 2-sided independent t- test. The sample size was determined from the results of previous studies with an alpha of 0.05 and 80% power (two-tailed), a 15% difference in the incidence of RD[7]. P- Values lower than 0.05 were considered statistically significant.

VII. Results

Patients were recruited and randomly assigned into group A and group B. The mean age was 41.86 years. In group A, the mean age was 42.37years. In group B, the mean age was 40.67years. In group A (20 participants), 11 patients were females and 9 were males; compared to 16 females and 14 males in groupB (30 participants). The identified retinal breaks in 50 cases were horseshoe tears, retinal dialysis ,round holes with opercula, round holes without opercula (atrophic Holes) and lattice degeneration.these breaks were distributed as upper temporal retinal breaks in10 participants, 12 o'clock breaks in4 participants, upper nasal retinal breaks in6 participants and lower retinal breaks in30 participants. These breaks were being single or multiple in this sample of patients. All participants had macular detachment at the time of diagnosis. There was significant difference in PVR state before surgery in both groups (P=.001). During surgery, iatrogenic retinal breaks (related to separation of posterior hyaloid with Tano scrapper) occurred in 3cases in group B. We did drainage

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retinotomy in 10 cases (group A-4 cases, group B- 6 cases). A retinal detachment was detected in silicone filled eye after 23- gauge vitrectomy in two cases of group B (Lower RD).

Baseline demographic and ocular characteristics were similar during comparison between both groups (Table- 1).

Demographic and clinical characteristics	Group A- 20 Cases	Group B- 30 Cases	p-Value
Ages	41.96±7.91	41.7±5.77	.92*
Sex, n(%) Female Male	 55% (11 F) 45% (9 M)	 53% (16 F) 47% (14M)	 .91**
Trauma with retinal detachment	2/20	2/30	
Myopia with retinal detachment	1/20	2/30	
Initial PVR-stage: A+B C	 18/20 2/20	 10/30 20/30	 .001*
Phakic eyes	18/20	28/30	.7*
Preceding Buckling procedure	2/20	4/30	.697*
horseshoe tears single more than one	12 cases -8 cases - 4 cases	10 cases -8 cases -2 cases	.065*
retinal dialysis	2cases	2cases	
round Holes with Opercula, single more than one	2cases - -2cases	6cases -2cases -4cases	.355*
round Holes without Opercula (Atrophic Holes) single more than one	1 case - -1case	6cases - -6 cases	.14*
lattice degeneration with breaks	3 cases	6 cases	.66*
follow-up period	380-420	590-670	0.046*
Refraction error (mean)	-3.87±2.15	-3.45±1.62	.56*
Visual acuity (Snellen) preoperative <0.1	20	30	.98*

Table -1.Data show the baseline demographic and clinical characteristics of patients in both groups of the study.

*assessed by independent t- test.

** assessed by chi-square test of independence.

After SO removal, the retina was completely reattached in 35/50 (group A- 17cases, group B- 18 cases). The failure rate after the first 23-gauge vitrectomy was (15/50) 0.3(group A-3cases, groupB-12 cases (P=.047)). In recurrent RD group (15 cases), the failure rate was 0.2. Twelve participants had flat retina after SO removal. Three cases of group A and nine cases of group B after two 23-gauge procedures had flat retina (P=.083).

Three cases of group B (recurrent RD group) needed more than two procedures.

The reattachment rate in both groups was affected by PVR, and reopening of retinal defects or developing new defect related to membrane proliferation. Reproliferations like epiretinal membranes, subretinal membranes and PVR grade C,D in (11/15 cases group B) had a statistically significant effect in group B (P=.000). Another causes of failure were missed or new breaks (group A- 2 cases , group B- one case), and inadequate silicone filling (group A- one case). Multivariate analysis was performed to assess preoperative, intraoperative and postoperative risk factors for 23- gauge vitrectomy. Proliferative vitreoretinopathy is the significant risk factor with weak clinical effect on comparing group A and group B(P<.000). Patient's age , refraction ,previous history of trauma, types of breaks , the state of lens (phakic or pseudophakic), iatrogenic breaks,and drainage retinotomy were not risk factors. The difference in visual acuity at 6 months (the final visual

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acuity) after SO removal in all participants in both groups was not significant (P=.099) . Table- 2

The final visual acuity was reported after one procedure (23-gauge vitrectomy) in 35 participants and repeated procedures (23-gauge vitrectomy) in 15 participants. Visual acuity ranged from 20/60 to 20/400 in both group participants. The visual acuity of 50 participants after silicone removal was good in eyes that often had only light perception before the first procedure. The frequent cause of vision deterioration was cataract, improved with cataract extraction and SO removal.

	GroupA (n= 20)	Group B (n 30)
Changes in mean VA postoperative	0.1-0.2 (.12)(P<.000)	0.1-0.12 (.11) (P<.000)
Improvement in PVR	NO Improvement (P=.155)	Improved (P<.000)

Table-2 Data show visual and PVR Recovery of eyes in both treatment groups.

Survival analysis revealed that, the time onset of postoperative RD in the first 3-6 months after SO removal has no statistical difference between both groups A and B (P=.404) Fig-1

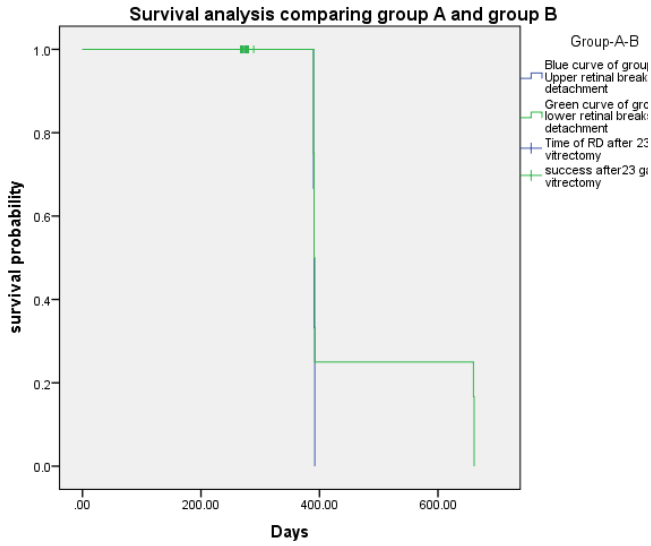

Fig-1. Kaplan-Meier survival analysis comparing group A (upper retinal break detachment) and group B (lower retinal break detachment) with respect to time of onset of RD after 23 gauge vitrectomy. No significant differences were observed (P= .404) between two treatment groups (A-B).

VIII. DISCUSSION

In this study we have 0.3 failure rate in all participants after the first 23gauge vitrectomy and SO removal. The failure rate was reduced to 0.2 after the second 23gauge vitrectomy and SO removal. Failure rate was ended after repeated vitrectomies and SO removal in the last three cases.

Multivariate analysis confirmed that there was statistical difference (P=.047) in the development of postoperative retinal detachment between the two groups after the first 23 gauge vitrectomy. The incidence of recurrent RD followed SO removal is variable: most studies have reported an incidence of 20–25%,[8 -12] some 15–20%,[13,14]and a few below10%[15,16]. Identification and closure of all retinal breaks is the key for successful PPV[17]. Several mechanisms can explain the redetachment process, reopening of pre-existing breaks, or new retinal break formation, and residual vitreoretinal traction at the vitreous base[18]. In PPV, there is search for breaks in detached retina facilitated by wide-angle viewing systems, internal illumination and indentation. Most of these breaks are leading to redetachment that occurred after the initial operation. We have evidence that induction of PVD in macular hole surgery creates new retinal breaks and RD in 3 to 11% of patients[19].

In this study PVR is the significant risk factor for recurrent RD while preoperative breaks and iatrogenic breaks were not risk factors. Despite that, these postoperative new breaks in recurrent RD seem to occur mostly in previously normal-looking retina without apparent signs of retinal degeneration. The progression of PVD into normal areas with strong vitreoretinal adhesions share in inducing postoperative breaks[20]. These breaks are not missed breaks in previously attached retina[21] or overlooked breaks[22].Vitreous base shaving should be complete especially around the breaks and areas of peripheral retinal degeneration to reduce the recurrence in RD surgery[23].

In both groups, the statistical difference in failure rate after the second 23- gauge vitrectomy is absent (P = .083).The new technology can help the different pathology in RD cases and improve the results. The using of a high-speed cutter can remove meticulously the PVD and the peripheral vitreous. Endolaser can give treatment of different extent (ranging from the equator to the ora serrata in all quadrants, to laser in three or four rows around the breaks)[11]. We have small series, and retrospective studies supporting 360 laser retinopexy[24-26]. In pseudophakic RD, 23- gauge vitrectomy can remove all vitreous traction on retinal tears and improved peripheral retina visualization[1].

In addition, inferior detachments on average tend to be of longer duration and display a higher rate of preoperative intravitreal fibrocellular proliferations compared with detachments of the upper quadrants[27]. To improve the success rates of vitectomy in patients with breaks including the inferior quadrants, several suggestions have been published, including support of these breaks with an additional encircling band[28], long-acting tamponades, e.g. C3F8, C2F6, silicone or heavy silicon[29-31]. We believe that, the laser given for inferior break should be wide, extended from equator to the ora, if we have multiple inferior breaks the laser shots must be continuous around all breaks, broad more to nasal and temporal sides and if there is evidence of reproliferations like subretinal bands, the laser can be extended 360 degrees. Laser in lower retinal breaks should be satisfied, complete and broad.

http://dx.doi.org/10.31364/SCIRJ/v9.i01.2021.P0121837

The preoperative visual acuity, preoperative ocular hypotony and the duration of macular detachment were the three best predictors of a good postoperative visual acuity. All participants have good visual acuity at 6 months after SO removal compared with the preoperative visual acuity. These results are comparable to most previous studies[32-37].

Survival analysis in this study revealed that the follow up time in upper retinal break detachment was shorter compared with lower retinal break detachment. This is in agreement with Sigler et al and Ambiya,etal [38].

IX. STUDY LIMITATION

Although we aimed to accomplish this complete randomized clinical study, inclusion into this study is subject to selection bias and requires minimum follow up time (390-660 days).

The number of participants is not large despite that, the study is a mirror of our results of 23-gauge vitrectomy for RD in clinical setting.

X. CONCLUSION

The first 23- Gauge vitrectomy has less failure rate in upper retinal break detachment compared with lower retinal break detachment. Proliferative vitreoretinopathy is the significant risk factor for recurrent RD. All participants have good visual acuity at 6 months after SO removal compared with the preoperative visual acuity.

Trial registration: The trial is registered at Research Ethical Committee, Ain Shams University FWA000017585 FMASU25/2017, Registered at the US National Institutes of Health (ClinicalTrials.gov- ID: NCT04280770) February 20, 2020-'Retrospectively registered'.

Funding: None

ACKNOWLEDGMENT

Special thanks for Prof, Osama Raslan for his support and the given training.

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