Surgical Failure Following Primary Retinal Detachment Surgery by 23-Gauge Vitrectomy: Preoperative Risk Factors Assessment

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Abstract

Aim of Study: To assess the preoperative risk factors implicated in increasing the risk of surgical failure in primary retinal detachment surgery using the 23-G vitrectomy platform.

Methods: Eighty eyes suffering from primary rhegmatogenous retinal detachment were treated with 23-gauge transconjunctival vitrectomy. A comprehensive ophthalmological examination including the duration of the detachment and the grading of PVR, if present, was performed preoperatively. Three months post tamponade removal the retinas were examined and the preoperative risk factors for surgical failure were analyzed.

Results: The overall primary success rate of retinal reattachment is 72.5% (58/80 eyes). Backward logistic multiregression analysis identified significant independent predictors of redetachment ($p<0.01$, Hosmer-Lemeshow, $\chi^2$: 7.593, $p=0.474$): Duration of detachment and preoperative visual acuity. Specifically, for every day more of duration of detachment, the odds of redetachment increased by a factor of 1.007 (95% Confidence Interval, CI: 1.000 to 1.015, $p<0.01$). Likewise, for every day more of duration of detachment, the odds of redetachment was increased by a factor of 8.840 if a preoperative visual acuity of HMBP or worse was present (95% CI 2.507 to 31.102, $p=0.05$).

Conclusion: Proliferative vitreoretinopathy (PVR) grade C, preoperative visual acuity of HMBP or less and the duration of the retinal detachment were risk factors for failure of retinal reattachment using 23-gauge transconjunctival vitrectomy.

Key Words: Rhegmatogenous Retinal Detachment (RRD) – 23 Gauge vitrectomy.

Introduction

RHEGMATOGENOUS Retinal Detachment (RRD) is a sight threatening condition which if not treated promptly and effectively may leave the eye dysfunctional and atrophic. Retinal detachment occurs in 1 in 10,000 to 20,000 persons per year [1-3]. Until the 1990s scleral buckling surgery was the method of choice in the vast majority of cases [4,5]. But with the advances that occurred in the PPV this trend has changed, with pars plana vitrectomy gaining popularity among vitreo-retinal surgeons, especially younger surgeons in the beginning of their surgical careers [6].

In order to shorten operative time and to minimize trauma to the eye considerable improvements in surgical techniques and equipment were developed. The first 20-G transconjunctival sutureless approach was introduced 1996 [7]. Then in 2002, Fujii et al., [8] presented a set of tools with a diameter of 25-G, followed by Eckardt et al., [9] in 2005 when he introduced the 23-G system. Finally, in 2010, Oshima et al., [10] introduced the 27-G transconjunctival system for performing a complete PPV. With continued improvements and innovations in the small gauge surgical tools, transconjunctival vitrectomy can now be used in virtually all retinal conditions necessitating surgery. Small gauge vitrectomy offers a wide range of advantages over the conventional 20-G system whilst maintaining the same success rates [9-12].

Retinal detachment varies markedly in severity; from innocuous sub-clinical detachments that could be treated by trivial procedures such as laser barrage [13] to extremely devastating clinical pictures of total, old standing detachments with extensive PVR and retinal fibrosis necessitating extreme maneuvers such as relaxing retinotomies. Reported preoperative characteristics that may be associated with an increased risk of surgical failure include duration of symptoms, extent of retinal detachment and involvement of inferior quadrants, multiple breaks, an absence of detectable retinal breaks, high myopia, hypotony, proliferative vitreoretinopathy (PVR) and surgical training [18-17]. Identification of such preoperative risk factors helps by
Material and Methods

In this prospective randomized controlled interventional study 80 consecutive eyes suffering from primary rhegmatogenous retinal detachment (RRD) were treated with 23-gauge transconjunctival vitrectomy. All patients were recruited between October 2011 and July 2012 form Kasr El-Aini outpatient clinic.

Inclusion criteria:

Primary rhegmatogenous retinal detachments with various grades of proliferative vitreoretinopathy (PVR) except for grade D (including subretinal membranes) that end up with complete retinal reattachment at the termination of surgery. Patients with a coincidental cataract that necessitated its simultaneous removal were included.

Exclusion criteria:

Patients with previously failed retinal procedures (previous scleral buckle, failed vitrectomy, pneumatic retinopexy or laser barrage treatment. Other retinal pathologies such as diabetic retinopathy and macular holes were excluded from this study. Detachments due to giant breaks or dialyses were also not included. Intraoperatively any detachment in which relaxing retinotomies had to be performed was also excluded from this study.

Examinations:

Preoperatively a full history, including any history of trauma, previous ophthalmic surgeries or procedures and the duration of detachment were noted. Best corrected visual acuity (BCVA), slit lamp examination of anterior segment structures, indirect ophthalmoscopy, and slit lamp biomicroscopy was done. PVR was graded according to the updated Retina Society classification.

Postoperative examination were scheduled at baseline then at 1 day, 1 week, 1 month then monthly until 3 months post silicone oil removal or gas absorption. At follow-up visits state the site of the retina, intraocular pressure (IOP) as well as any other observations were noted.

Surgical technique:

Surgery was performed under general or local anesthesia with retrobulbar block. The surgical procedure was based on 23-gauge transconjunctival sutureless vitrectomy using a one-step system (Alcon Laboratories, Inc., Fort Worth, TX, USA). The conjunctiva was displaced and 30-degree angled incisions were made through conjunctiva, sclera, and pars plana 3.5-4mm from the corneoscleral limbus with a 23-gauge blade-trocar system in order to obtain tunnels parallel to the corneoscleral limbus. The ACCURUS or CONSTELATION vitrectomy system with dual pneumatic cutters and halogen bulb light source (Alcon Laboratories, Inc., Fort Worth, TX, USA) was used for all cases. The IOP was maintained between 30 and 40mmHg. The 3D-vitrectomy mode with cutting rate up to 5,000 cuts per minute (cpm) and vacuum of up to 500mmHg was used. A core vitrectomy was performed after the induction of Posterior Vitreous Detachment (PVD) using cutting off mode with high vacuum in all cases. Perfluorocarbon liquid (PFCL) was used at the discretion of the surgeon to flatten the posterior retina. The vitreous-base was thoroughly trimmed with the help of scleral indentation; no relaxing retinotomies was done, although draining retinotomies were done if posterior subretinal fluid was noted. Triamcinolone Acetonide was used at the surgeons discretion for staining of the vitreous. After complete removal of the vitreous, any epiretinal membranes were dissected and removed. Then the retinal periphery was inspected for retinal breaks, and any break found was treated with laser retinopexy, followed by 2 rows of 360 degree laser in the area of the vitreous base. Fluid-air exchange (FAX) was then performed. At this point the eyes enrolled in this study were randomly assigned to either left with a non-expansible mix of gas (either SF6 or C2F6) or 1000 centistoke (cSt.) silicone oil as a tamponading agent. After insuring an adequate fill of either tamponading agent, the trocar cannulas were slowly removed and the sclerotomies gently massaged with a blunt solid instrument. Sclerotomy sights were meticulously examined for any leaks and sutured if their self-sealing ability was in doubt. Postoperative treatment consisted of topical antibiotic drops, a topical steroid preparation both q.i.d. and a combined antibiotic/steroid ointment at night for a period of 1 month. Posturing was maintained for one week and silicone oil removal was planned after a period of 3 months after the initial surgery. Silicone oil removal was either done through an anterior approach entailing a phacoemulsification followed by a posterior capsulorhexis., through which saline was infused while concomitantly removing the oil either passively by depressing the corneal wound or actively by aspiration by a 20-G cannula. Or the oil was removed through the posterior approach by inserting.
3 23-G cannulas and removing the oil through both active suction and/or passive diffusion. The decision to use either technique was governed by if the patient needed a simultaneous lens removal at the time of oil extraction or not.

Outcome measures:
The outcome measure was the success rate of retinal reattachment throughout the follow-up period up until 3 months after either spontaneous absorption (gas) or active removal (silicone) of the tamponading agent.

Results

Patients analysis:
A total of 80 eyes of 80 patients are included in the study, of whom 53 are male (66.3%) and 27 are female (33.8%). The mean age of the patients is 43 (range 11-72 years). The detachments were found in the right eye (OD) in 41 (51.3%) and in the left eye in the remaining 39 (48.8%) of the patients. Of these 80 patients 20 (25%) reported a prior history of blunt trauma. At the time of surgery 21 (26.3%) of the patients were pseudophakic (Table 1).

During the preoperative examination PVR was found in 73 (91%) of the cases. PVR grade (A) was present 15%, grade (B) in 41.3%, grade (C) in 35% and no PVR in 8.8% of the cases. The mean duration of the detachment, which is defined as the time passed since the patient noticed his symptoms to the time of the surgery, was 54.3 days (SD 18.7) (range 1-365 days).

Retinal redetachment analysis:
The overall primary success rate of retinal reattachment is 72.5% (58/80 eyes). In all 22 cases in which the retina redetached, the redetachment occurred within 2 months of either removal or absorption of the tamponading agent. Specifically, 59.1% of the redetachments occurred during the first month and the remaining 40.9% detached within the second month post tamponade clearance.

Multi-variate analysis of all factors was done to identify those factors that had a statistically significant effect on the rates of redetachment. The factors revealed in this analysis are preoperative visual acuity and the duration of retinal detachment (irrespective of presence of PVR). PVR itself was not a statistically significant factor (Table 3).

Table (1): Demographics of patients recruited.

<table>
<thead>
<tr>
<th>Demographic characteristics of study patients</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>80</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>53/27</td>
</tr>
<tr>
<td>Age</td>
<td>43.2±14</td>
</tr>
<tr>
<td>Eye (right/left)</td>
<td>41/39</td>
</tr>
<tr>
<td>Trauma (yes/no)</td>
<td>20/60</td>
</tr>
<tr>
<td>Pseudophakia (yes/no)</td>
<td>21/59</td>
</tr>
<tr>
<td>Preoperative BCVA (d HMBP/e HMGP)</td>
<td>29/51</td>
</tr>
</tbody>
</table>

Retinal detachment analysis:
Of the 80 detachments included, 44 (55%) were total and 36 (45%) were subtotal. The macula was attached in 3 (3.8%) and detached in 77 (96.3%) of the cases. Inferior tears, defined as tears located from the 4 to 8 o’clock, were present in 33 (41.3%) of the detachments. Multiple tears were found in 41 (51.3%) of the detachments (Table 2).

Table (2): Characteristics of the retinal detachments.

<table>
<thead>
<tr>
<th>Retinal detachment characteristics</th>
<th>Variable (redetachment-attachment)</th>
<th>p-value (chi-square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of detachment</td>
<td>54.3±80.7 days</td>
<td></td>
</tr>
<tr>
<td>Total/subtotal</td>
<td>44/36</td>
<td></td>
</tr>
<tr>
<td>Macula-on/macula-off</td>
<td>3/77</td>
<td></td>
</tr>
<tr>
<td>Inferior tear</td>
<td>41.3%</td>
<td></td>
</tr>
<tr>
<td>Multiple tears</td>
<td>51.3%</td>
<td></td>
</tr>
<tr>
<td>PVR (yes/no)</td>
<td>73/7</td>
<td></td>
</tr>
<tr>
<td>Preop VA (HMBP or worse-HMGP or better)</td>
<td>&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

Table (3): Analysis of different factors contributing to retinal redetachment.

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value (chi-square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male-female)</td>
<td>0.45</td>
</tr>
<tr>
<td>Trauma (No-Yes)</td>
<td>0.15</td>
</tr>
<tr>
<td>Gas-silicone</td>
<td>0.32</td>
</tr>
<tr>
<td>Subtotal-total</td>
<td>0.14</td>
</tr>
<tr>
<td>Macula off-on</td>
<td>0.28</td>
</tr>
<tr>
<td>Number of tears (1-More than 1)</td>
<td>0.17</td>
</tr>
<tr>
<td>Inferior tear (no-yes)</td>
<td>0.14</td>
</tr>
<tr>
<td>Pseudophakia (no-yes)</td>
<td>0.66</td>
</tr>
<tr>
<td>PVR (no-yes)</td>
<td>0.06</td>
</tr>
<tr>
<td>Preop VA (HMBP or worse-HMGP or better)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Retinal redetachment occurred in 22.5% of patients that had any grade of PVR, versus only 5.0% of those patients that did not have PVR ($p=0.06$) which is not statistically significant. But when subanalysis was done it revealed that specifically grade C PVR compared to other PVR grades was a statistically significant factor for poor surgical outcomes (grade A vs. C $p=0.05$) (grade B vs. C $p=0.06$). Surprisingly when compared to the absence of PVR there was no statistically significant correlation, but that could be explained by the very small number of eyes that did not have any grade of PVR ($n=12$).

Analysis also showed that patients with preoperative visual acuity of d HMBP had a statistically higher rate of retinal redetachment versus patients with visual acuity of e HMGP ($p=<0.01$).

The duration of the detachment, irrespective of the presence or absence of PVR, had a statistically significant influence on rates of redetachment ($p=<0.01$). In the eyes in which the retina did not redetach the mean duration of detachment in days was $35.9\pm12.3$ (range 1-365) and in the eyes that the retina redetached was $102.7\pm91.2$ (range 2-365).

Backward logistic multi-regression analysis identified significant independent predictors of redetachment ($p<0.01$, Hosmer-Lemeshow, $\chi^2$: 7.593, $p=0.474$): Duration of detachment and preoperative visual acuity. Specifically, for every day more of duration of detachment, the odds of redetachment increased by a factor of 1.007 (95% Confidence Interval, CI: 1.000 to 1.015, $p<0.01$). Likewise, for every day more of duration of detachment, the odds of redetachment was increased by a factor of 8.840 if a preoperative visual acuity of HMBP or worse was present (95% CI 2.507 to 31.102, $p=0.05$).

**Discussion**

Although great improvements in the surgical outcomes of vitrectomy for RRD have occurred over the last decade, the results are still far from perfect. Success rates of primary repair range from 62.6% to 98.3% and 80% to 96.2% for 20-gauge and 23-gauge vitrectomy respectively [18]. Primary success in surgery for rhegmatogenous retinal detachments is of utmost importance. Studies have shown that visual recovery decreases exponentially with subsequent surgeries [19,20].

In our study, the overall success rate for primary repair of rhegmatogenous retinal detachments was 72.5%, and a final reattachment rate of 85%, which is lower than most published data, especially more recent papers that put primary success rates between 80% and 96.2% [18]. There are numerous explanations as to why our result differs from the more recently published data. The eyes that had been recruited in the other studies had macula-on detachments in 37 to 54% of the cases. Minimal PVR (grade B or less), and an average duration of the detachment of 7 days [21-23]. In contrast, we had macula on detachments in only 3.6%, PVR in 91%, including 35% with PVR grade C, and the average duration of the detachments was 54.3±80.7 days in my study group.

Previously numerous factors have been shown to be associated with failure to reattach the retina. The duration of symptoms, low preoperative visual acuity, myopia, amblyopia, hypotony, macular detachments, preoperative PVR, extent of the detachment, involvement of inferior quadrants, undetectable breaks, large breaks, breaks posterior to the equator, surgeon factor and level of surgical training [24]. The two strongest predictors of surgical failure in our study were a preoperative visual acuity and the duration of retinal detachment ($p=<0.01$). In the eyes in which the retina did not redetach the mean duration of detachment in days was $35.9\pm12.3$ (range 1-365) and in the eyes that the retina redetached was $102.7\pm91.2$ (range 2-365). James et al., investigated the success rate after surgery for chronic retinal detachments (defined as duration of ≤3 months) and found that after exclusion of PVR, the success after single procedure was seen in 8 of 14 cases (57.1%) of chronic retinal detachments versus 92 out of 107 (86.0%) of fresh retinal detachments [25].

Even though proliferative vitreoretinopathy (PVR) represents a major cause of failure of retinal detachment surgery [26,27] in our study multivariate analysis showed no association between the anatomic success rate and the existence of PVR in general. But with sub-analysis of PVR it was revealed that grade C PVR compared to other PVR grades was a statistically significant factor for poor surgical outcomes (grade A vs. C $p=0.05$) (grade B vs. C $p=0.06$). Surprisingly when compared to the absence of PVR there was no statistically significant correlation, but that could be explained by the very small number of eyes that did not have any grade of PVR ($n=12$).

In our study, eyes with preoperative visual acuity of d HMBP had a 20% chance to develop a redetachment compared to 7.5% in eyes with e HMGP ($p=0.01$). The explanation for this obser-
vation is that visual acuity of d HMBP is usually associated with other risk factors for retinal detachment, such as chronicity of the condition and the presence of PVR. The correlation of preoperative visual acuity to surgical outcome was also demonstrated in numerous studies \(^{28,29}\).

**Conclusion:**

The statistically significant preoperative risk factors that have a poor prognostic effect on surgical outcomes are preoperative visual acuity of HMBP or worse and a longer duration of the retinal detachment. Proliferative vitreoretinopathy was not a statistically significant factor mainly due to the small sample size of eyes without proliferative vitreoretinopathy (i.e. high incidence of PVR in our study). But it was noted that if PVR is present then grade C of this pathology carries a statistically significant effect favoring surgical failure.

**References**


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Surgical Failure Following Primary Retinal Detachment Surgery


الملخص العربي

يعتبر انفصال الشبكية حالة تهدد بفقدان النظر وإذا لم تعالج بسرعه يفاق عليه فإن حالة انفصال الشبكية تضعف الأبصار إلى درجة تقترب من فقدان النظر. وبالتالي فإن معالجة انفصال الشبكية سيطرة دائما موضوع بالأمنية لكل الجراحين المتخصصين في الجراحات الخاصة بالجسم الزجاجي والشبكية. هناك أجراءات تستخدم بنجاح في إصلاح الانفصال الشبكية. على مدى السنوات الخمس عشرة الأخيرة أصبح استئصال الجسم الزجاجي هو الوسيطة المفضلة لدى الجراحين المتخصصين في هذا المجال. والداخلي لذا ان عملية استئصال الجسم الزجاجي تعالج الحالة المرضية المؤلمة في انفصال الشبكية وعادة ما تكون شديد الجسم الزجاجي على الشبكية، أما الداعي الثاني فهو التقدم الكبير الذي حدث ملحوظا في تقنية عملية استئصال الجسم الزجاجي.

وقد أثبتت دراسات عديدة أن النجاح النهائى في عودة الشبكية إلى مكانها الأصلي الطبيعي والتحسين في حدة الإبصار يتوقف على حد كبير على عدد الجراحات التي أجريت لاستئصال الشبكية ويدل كل ذلك أن الحد من عدد تلك الجراحات هو الأفضل. فهذا السبب التعريف على المؤشرات السلبية الموجودة قبل العملية التي يمكن أن تؤدي إلى إرتجاع في الإنفصال الشبكية في غاية الأهمية لتحقيق أعلى معدل نجاح.

في دراستنا هذه تمكننا حالة عيون مصاب إInputs retinal detachment (PVR C) (الضوء) فيما أقر أو وجود تأثير على سطح الشبكية بالتتابع. وكما زادت فترة الإبصار فنسبة حدوث إرتجاع في إنفصال الشبكية زادت.