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Treatment Results, Factors Affecting the Success of Pneumatic Retinopexy in Rhegmatogenous Retinal Detachment, and the Importance of Other Eye Follow-Ups: Case Series

Yırtıklı Retina Dekolmanında Pnömatik Retinopeksinin Tedavi Sonuçları, Başarıyı Etkileyen Faktörler ve Diğer Göz Takiplerinin Önemi: Olgu Serisi

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ABSTRACT Objective: To reveal the factors affecting the surgical outcomes and pathological findings in the fellow eye in patients who underwent pneumatic retinopexy (PR) for rhegmatogenous retinal detachment (RRD). **Material and Methods:** Patients treated for RRD between 2014 and 2021 were evaluated retrospectively. The study included 43 eyes of 18 female and 25 male patients who underwent PR. Age, gender, best-corrected visual acuity (BCVA), lens status, number of preoperative tears, macular involvement, tamponade, intraocular pressure, and anatomic success were evaluated preoperatively and at the last visit. The fellow eye findings were also investigated. **Results:** Retinal reattachment was observed in 21/43 (48%) eyes. Macular involvement was present in 24 (55.8%) patients. The mean BCVA before surgery was 1.4±1.2 logarithms of minimum angle resolution (logMAR), and the mean BCVA at the final follow-up after surgery was 0.8±0.9 logMAR (p=0.003). Macular involvement, gas type (sulfur hexafluoride-perfluoropropane), lens status (phakic-pseudophakic), and the location of the tear quadrant (2 o'clock/10 o'clock) were not determined to affect the surgical success (p=0.43, p=0.37, p=0.15, p=0.73, respectively). Surgical success increased to 85% at the 1-year follow-up with secondary procedures. Lattice degeneration was found in 3 (7%) patients, retinal detachment in 4 (9%) patients, and retinal tear in 2 (4%) patients in the fellow eye of RRD. **Conclusion:** Although PR is a cost-effective method in RRD treatment, an additional surgical procedure may be required during follow-up. Detailed evaluation of the fellow eye pathologies is critical to prevent RRD development.

Keywords: Fellow eye; lattice degeneration; pneumatic retinopexy; retinal detachment; retinal tear

ÖZET Amaç: Yırtıklı retina dekolmanı [rhegmatogenous retinal detachment (RRD)] nedeniyle pnömatik retinopeksi (PR) uygulanan hastalarda cerrahi sonuçları etkileyen faktörleri ve diğer gözdeki patolojik bulguları ortaya çıkarmak. **Gereç ve Yöntemler:** RRD nedeniyle 2014-2021 yılları arasında tedavi edilen hastalar geriye dönük değerlendirildi. Çalışmaya PR yapılan 18 kadın, 25 erkek hastanın 43 gözü dâhil edildi. Hastaların yaşı, cinsiyeti, en iyi düzeltilmiş görme keskinliği (EİDGK), lens durumu, ameliyat öncesi yırtık sayısı, makula tutulumu, tamponad, göz içi basıncı ve anatomik başarıları ameliyat öncesi ve son vizitte değerlendirildi. Ayrıca diğer göz bulguları da araştırıldı. **Bulgular:** Retinanın 21/43 (%48) gözde yatıştığı gözlendi. Yirmi dört (%55,8) hastada makula tutulumu mevcuttu. Ameliyat öncesi ortalama EİDGK 1,4±1,2 minimum çözünürlük açısının logaritması [logarithms of minimum angle resolution (logMAR)] ve ameliyat sonrası son takipte ortalama EİDGK 0,8±0,9 logMAR idi (p=0,003). Makula tutulumu, gaz tipi (sülfür hekzaflorit-perfloropropan), lens durumu (fakik-psödofakik) ve gözyaşı kadranının yerleşimi (saat 2 ve 10) cerrahi başarıyı etkilemedi (sırasıyla p=0,43, p=0,37, p=0,15, p=0,73). İkincil işlemlerle 1 yıllık takipte cerrahi başarı %85'e yükseldi. Ayrıca RRD'nin diğer gözünde 3 (%7) hastada latis dejenerasyonu, 4 (%9) hastada retina dekolmanı ve 2 (%4) hastada retina yırtılması saptandı. **Sonuç:** PR, RRD tedavisinde maliyet etkin bir yöntem olmasına rağmen takip sırasında ek bir cerrahi işlem gerekebilir. Diğer göz patolojilerinin ayrıntılı değerlendirilmesi, RRD gelişimini önlemek için kritik öneme sahiptir.

Anahtar Kelimeler: Diğer göz; latis dejenerasyonu; pnömatik retinopeksi; retina dekolmanı; retina yırtığı

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Rhegmatogenous retinal detachment (RRD) is an acute, vision-threatening condition with an incidence of approximately 10 in 100,000 people. Pneumatic retinopexy (PR) is a minimally invasive surgical intervention to re-attach a detached retina. Hilton and Grizzard first described PR as an office-based procedure for managing freshly ruptured retinal detachment.[1] An expandable gas is injected into the vitreous, then laser photocoagulation is performed around the retinal tears. The use of PR has been limited because of limited indications and low initial surgical success rate compared to pars plana vitrectomy (PPV) and scleral buckling (SB). It is a method that gives good results in carefully selected patients. PR is associated with lower morbidity, lower cost, and faster postoperative recovery than PPV and SB, the other modalities for treating RRD. One of the most critical difficulties is that it requires patient positioning according to the location of the tear for about a week after the application.[2-6]

PR is classically indicated for fresh retinal detachments in phakic eyes containing break/break clusters of no more than 1 hour, together with retinal detachment not exceeding the 8 o'clock position in the superior retina. Reported success rates of PR alone range from 60-80%.[7]

This study aimed to present the anatomic and visual results and complications of cases that underwent PR for RRD in our clinic between 2014 and 2021 and to examine the preoperative and postoperative factors that may affect the success of the procedure. A secondary aim was to examine the retinal pathologies and progressions in the fellow eyes of the patients.

MATERIAL AND METHODS

In this retrospective, cross-sectional, single-center study, a retrospective evaluation was made of patients treated for RRD between 2014 and 2021 in the eye clinic of a tertiary-level university hospital. The study included 43 eyes of 43 patients who underwent PR for RRD. The study protocol was approved by the Clinical Research Ethics Committee of Haydarpaşa Numune Training and Research Hospital (date: April 18, 2022, no: 2022/92). All the study procedures complied with the principles of the Declaration of Helsinki. Informed consent was waived by the Ethics Committee due to the retrospective nature of the study.

All the patients diagnosed with RRD underwent a detailed examination. Relevant clinical and surgical history information was collected. Best-corrected visual acuity (BCVA), measured on the Snellen eye chart, was recorded before surgery and at the final visit and was converted to logarithms of minimum angle resolution (logMAR) acuity. All the patients in the study underwent a comprehensive ophthalmological examination, including slit-lamp biomicroscopy and dilated fundus examination.

All patients underwent anterior chamber paracentesis under topical anesthesia, followed by 0.3 cc perfluoropropane (C_3F_8) or 0.5 cc sulfur hexafluoride (SF_6) injection with a 30-gauge needle through the pars plana by a single surgeon (XX). The choice of SF_6 or C_3F_8 was made according to the break location and size. C_3F_8 was used for more posteriorly located breaks larger than 3 o'clock and SF_6 was used for breaks smaller than 3 o'clock. The patients were positioned appropriately according to the break site for 3 days. Laser photocoagulation was applied to the areas around the tear where the subretinal fluid was absorbed in the 1 to 3-day follow-up examinations after the procedure.

Age, sex, lens condition, number and location of preoperative tears, detachment size, macular involvement, tamponade, complications, and anatomic success data were evaluated. The cases in which retinal attachment was achieved with PR and laser application and the patients who did not require PPV were considered anatomically successful.

Patients who underwent PR due to RRD were included in this study. PR indication was applied for breaks located within the superior 8 o'clock (between 8 and 4 o'clock positions) and not exceeding 1 o'clock.[8] Exclusion criteria were defined as any ocular surgery other than cataract surgery, the presence of pathologic myopia, the presence of proliferative vitreoretinopathy (PVR), and RRD with a giant retinal tear.

SPSS software (SPSS for Windows, Version 22.0; SPSS, Chicago, IL, USA) was used for data

TABLE 1: Demographic and baseline characteristics of the patients.

Variables	
Age (years) ($\bar{X}$±SD)	56.6±2.1
Sex n (%)	Female; 18 (41.9), male; 25 (58.1)
Preoperative BCVA (mean logMAR)	1.4
Postoperative BCVA (mean logMAR)	0.5
Macula-on/off n (%)	24 (55.8)/19 (44.2)
Number of breaks (mean, minimum/maximum)	1.1 (1/3)
Gas type n (%)	SF_6 30 (67), C_3F_8 13 (25)
Retinal reattachment success in the first surgery n (%)	21/43 (48)

SD: Standard deviation; BCVA: Best-corrected visual acuity; logMAR: Logarithms of minimum angle resolution; SF_6: Sulfur hexafluoride; C_3F_8: Perfluoropropane.

TABLE 2: Surgical success in the patient groups.

Surgical outcome	Macula-on	Macula-off	p*
Successful	13	8	0.43
Unsuccessful	11	11	
	SF_6	$C3F_8$	p*
Successful	16	5	0.37
Unsuccessful	14	8	
	Phakic	Pseudophakic	
Successful	16	5	0.15
Unsuccessful	11	9	
	Tear in 10-2 o'clock quadrants	Tear in other quadrants	
Successful	13	6	0.73
Unsuccessful	12	7	

Chi-square test, p*<0.01; SF_6: Sulfur hexafluoride; C_3F_8: Perfluoropropane.

analysis. Data distribution was analyzed with the Shapiro-Wilk test. General information about the patients was explained. Descriptive statistics were performed. Numerical variables were expressed as mean or median values and categorical variables as frequency. A chi-square test was performed to investigate the effects of factors on the anatomic outcome, and regression analysis was performed to evaluate their effects on postoperative vision. A value of p<0.05 was considered statistically significant.

RESULTS

The evaluation was made of a total of 43 eyes of 43 patients, comprising 18 (41.9%) females and 25 (58.1%) males with a mean age of 56.6±2.1 years. The male/female ratio was 18:25. The demographic and baseline characteristics of the patients are shown in Table 1. After the PR procedure, retinal reattachment was observed in 21/43 (48%) eyes, and the retina did not reattach in 22 (52%) eyes in the first surgery. Macular involvement was present in 24 (55.8%) patients. The mean BCVA was 1.4±1.2 logMAR before surgery, and 0.8±0.9 logMAR at the final follow-up after surgery (p=0.003). The mean number of tears was 1.1. It was seen that 28 (65%) patients were phakic, and 15 (35%) were pseudophakic. Mean intraocular pressure was 13.3±2.5 preoperatively and 15.4±4.9 postoperatively (p=0.13). SF_6 was used in 30 (67%) patients and C_3F_8 in 13 (25%) (Table 2). In the evaluations of macular involvement, gas used (SF_6-C_3F_8), lens status (phakic-pseudophakic), and the location of the tear quadrant (2 and 10 o'clock- the other quadrants), no significant difference was determined between the groups in respect of surgical success (p=0.43, p=0.37, p=0.15, p=0.73, respectively) (Table 3). In addition to the first surgery, 3 (7%) patients underwent the second PR due to insufficient gas volume, and 14 (32%) underwent PPV. Surgical success increased to 85% at the 1-year follow-up after the secondary procedures. When the fellow eye findings were evaluated, lattice degeneration was found in 3 (7%) patients, retinal de-

TABLE 3: Regression analysis of the effect of variables on postoperative BCVA.

Variables	B	Standard error	Beta	t	p*
Preoperative BCVA (logMAR)	0.265	0.196	0.325	1.356	0.189
Age	-0.002	0.015	-0.022	-0.118	0.907
Sex	-0.168	0.344	-0.087	-0.488	0.631
Lens type	0.464	0.409	0.207	1.135	0.269
Gas type	-0.052	0.261	-0.036	-0.198	0.845
Macula-off	0.632	0.426	0.325	1.483	0.152

Regression analysis, r=0.66, r^2=0.44, p*<0.01; BCVA: Best-corrected visual acuity; logMAR: Logarithms of minimum angle resolution.

tachment in 4 (9%) patients, and retinal tear in 2 (4%) patients. Pathology in the fellow eye was determined in 20% of the patient group.

DISCUSSION

PR is a low-cost, in-office procedure for RRD treatment that does not require a severe learning curve. Although PR can be an effective method in shallow RRD with superior tears, it cannot be applied in RRD with large, bullous, and inferior tears and PVR. Due to its advantages, it can be preferred as a primary procedure over PPV with an appropriate indication in RRD treatment. Surgical failure may occur in approximately one-quarter of the patients who undergo PR, and additional interventions may be required.[8] In the current series, success in attaching the retina in the first surgical intervention was achieved at the rate of 48%, and 85% success was obtained at the one-year follow-up examination. There was also determined to be a significant increase in BCVA compared to pre-surgery (1.4 vs. 0.5 logMAR p=0.003).

As mentioned above, PR does not have a steep learning curve. In parallel with this information, Emami-Naeini et al. investigated the effects of first and second-year fellows on anatomic and surgical success and found no difference.[9] Therefore, PR can be easily applied in appropriate cases. Moreover, vision-related functioning scores and mental health scores have been reported to be better in patients who underwent PR procedures than in PPV.[5] Furthermore, due to the potential adverse effects of silicone oil on the retina, gas use in appropriate cases emerges as an advantage factor.[10]

The inventor of this surgical procedure, Tornambe, applied PR to 302 patients with RRD and achieved a success rate of 68% in a single surgical intervention and 95% with additional surgeries.[11] In a review conducted by Chan et al., the rate of PR efficacy in surgical success was found to be approximately 75%, ranging from 45% to 90%. Zaidi et al. reviewed 61 cases that underwent PR procedure and reported similar success rates; retinas were successfully attached with a single PR procedure in 33 of 61 (54%) patients, and with repeat PR or gas injection, successful retina re-attachment was obtained in 40 of 61 (66%) patients.[8,12] It was also reported in that study that age, myopia, lens status, and the number of breaks were not considered risk elements for surgical failure. Anaya et al. investigated the effect of secondary surgery (SB, PPV, SB+PPV) in 73 failed cases of 423 primary PR procedures and suggested retinal attachment for secondary PR. The rates of PPV, and SB+PPV after failed PR were lower than published success rates for their use in primary RRD.[13] In line with that study, Demircan et al. compared secondary PPV in patients with failed PR procedures and primary PPV in RRD, and reported no difference in surgical success.[14] They also reported that lens status and intraocular tamponade type (gas vs. silicon oil) did not affect surgical success. Unlike the current study, functional success (visual outcomes) and macular status were positively correlated in that study. In contrast, Glica et al. showed that male gender, macular off RRD, preoperative BCVA<20/50, complications, and missed/new retinal tears were associated with a poor prognosis for primary visual and anatomic success in the PR procedure.[15] A recent study conducted by Ong et al. reported that other procedures (PPV, SB, PPV+SB) have a higher surgical achievement rate than PR for one-year single surgery anatomic success.[16]

In the current series, macular involvement, gas types (SF_6-C_3F_8), lens status (phakic-pseudophakic), and the location of the tear quadrant (2 and 10 o'clock- the other quadrants) did not affect the surgical success rate. There are many different results in the literature regarding these evaluated parameters.[3,8,9,16,17] The main factors affecting these results are thought to be related to the surgeon's experience, the differences in patient selection, and the evaluation of the results in a narrow sample size. For example, Rootman et al. showed that the position and number of the breaks and macular status were similar to the current study results, and the extent and number of lattice degenerations did not affect surgical success.[17] However, the multivariate analysis results showed that break size was associated with failure, with an increased failure rate of PR in a break greater than 1 clock hour or RRD greater than 4.5

clock hours. Although the PR procedure is widely used for superior RRD, it has also been reported in the literature in patients with inferior RRD. Hwang et al. performed the PR procedure on patients with inferior RRD who could lie in the lateral recumbent position, and retinal reattachment was seen in 10 of 13 eyes (76.9%).[18] Alali et al. similarly applied the PR procedure to patients with inferior RRD and achieved success in 65% of 26 eyes.[19] These reported success rates show that the localization of the break, as well as the importance of the appropriate postoperative position, affect surgical success.

As mentioned in detail above, many parallel or different results have been reported in the literature on the PR procedure. With current developments in technology and the support of the industry, PPV comes to the fore in the treatment of RRD. This reduces the preferability of PR, which is a less invasive and cost-effective procedure with an easy learning curve. The most crucial purpose of this article is to raise awareness that PR can be used in the treatment of RRD within the appropriate indication and also allow more invasive procedures such as PPV or SB when necessary.

It is known that tears in pseudophakic RRD have a more atypical localization and are located more posteriorly. In our series, the success rate is higher in phakic RRDs, but this difference is not statistically significant. This may be related to the fact that phakic and pseudophakic RRDs undergoing PR procedure have similar tear localization and RRD area. PR procedure is to be applied within certain indications, even if it is definite and relative. In line with this information, Kleinmann et al. compared the success rate in phakic and pseudophakic RRDs and could not reveal a statistically significant difference in success, similar to our series.[20]

Although the PR procedure is generally accepted for RRDs due to breaks between 8 and 2 o'clock, this indication has no definitive validity. However, the PR procedure was performed for breaks outside this quadrant in this series. There are different rates reported in the literature. As stated in a review, the success of the PR procedure varies between 45% and 90% in different series.[8] It is thought that the emergence of different rates in the series may vary depending on the experience of the surgeon, the difference in the patient population, the relatively small number of patients taken, and the break localization.

The small sample size of this study did not allow subgroups to be analyzed, so the results should be validated in a more extensive series. As the PR procedure is less invasive than other surgical options in RRD treatment, the negative impact on BCVA is minimal. At least the results of this study show that the PR procedure can be safely applied to patients with appropriate indications and that more invasive procedures can be easily applied as a secondary procedure. Another limitation of this study was its retrospective nature. In the next stage, further prospective studies will be able to reveal the advantages and disadvantages of the methods in more depth by comparing the results of patients who underwent PR, PPV, and SB for RRD treatment in our hospital. A further limitation could be said to be that since the main aim of this study was to evaluate anatomic and functional surgical success, the cost-effectiveness of the method could not be investigated.

Another critical topic is the fellow eye findings in RRD. In this series, 20% of the patient group had pathology in the fellow eye [Lattice degeneration in 3 (7%) patients; RRD in 4 (9%) patients, and retinal tear in 2 (4%) patients]. In the Scottish Retinal Detachment Study, the fellow eye findings of 1202 patients with RRD were evaluated, and full-thickness retinal breaks were observed in 8.4% (95/1,130) of the fellow eyes at the time of presentation.[21] In addition, lattice degeneration was seen in 14.5% (164/1,130) of the fellow eyes, 7.3% (88/1,202) of cases had RRD in both eyes, and 60% of consecutive bilateral RRD cases presented before the macula were detached.[21] The fellow eye of RRD cases carries a significant risk for rhegmatogenous disorders. RRD is more common in high myopic and pseudophakic individuals. Fellow eye RRD is a more significant possibility of fast presentation with a smaller detachment area and attached macula than unilateral RRD, which increases the patient's awareness of the symptoms. Therefore, the detection of concomitant eye pathology is a cornerstone to prevent the development and complication of RRD.

CONCLUSION

Although PR is considered by most to be a cost-effective technique for the initial intervention of RRD, it is not currently widely used. Although its success may vary depending on the localization of the tear and RRD, on the other hand, as a minimally invasive procedure, PR remains an excellent option for treating RRD in patients with appropriate indications.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Abdullah Ağın;* ***Design:*** *Abdullah Ağın;* ***Control/Supervision:*** *Aysun Yücel Gençoğlu, Abdullah Ağın, Yücel Öztürk;* ***Data Collection and/or Processing:*** *Aysun Yücel Gençoğlu, Yücel Öztürk;* ***Analysis and/or Interpretation:*** *Aysun Yücel Gençoğlu, Abdullah Ağın, Yücel Öztürk;* ***Literature Review:*** *Aysun Yücel Gençoğlu, Abdullah Ağın;* ***Writing the Article:*** *Aysun Yücel Gençoğlu, Abdullah Ağın;* ***Critical Review:*** *Abdullah Ağın;* ***References and Fundings:*** *Aysun Yücel Gençoğlu, Abdullah Ağın;* ***Materials:*** *Aysun Yücel Gençoğlu, Yücel Öztürk.*

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