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Preoperative Characteristics Affecting the Outcome of Pneumatic Retinopexy Using Only Air

Ting Wang[1], Min Shi[2], Chaopeng Li[1], Shi Zhou[1] and Haijing Cao[1]*

[1]Department of Ophthalmology, The Affiliated Huaian No.1 People's Hospital, Nanjing Medical University, China

[2]Department of Endocrinology, The Affiliated Huaian No.1 People's Hospital, Nanjing Medical University, China

Abstract

Importance: Pneumatic retinopexy remains attractive due to numerous advantages.

Background: To provide references for improving the success of pneumatic retinopexy using only air.

Design: A Single-center, retrospective study was performed on a consecutive series of patient visits in a university hospital.

Participants or Samples: 72 eyes of patients with fresh primary RRDs were included if the anatomical outcomes were available at 6 months.

Methods: The preoperative characteristics of patients who underwent pneumatic retinopexy for the repair of primary rhegmatogenous retinal detachment, from December 2017 to June 2020, were retrieved from clinical records and retrospectively analyzed. Patients were only included if anatomical outcomes were available at 6 months.

Main Outcome Measures: The following preoperative characteristics were extracted from the medical records: Age; sex; duration of symptoms; refractive status; lens status; location and size of breaks; extent of the retina detachment; and the presence or absence of a visible traction of the whole gap.

Results: High myopia and visible vitreous traction on retinal breaks were independent risk factors. The other preoperative characteristics had no impact on the success of PR.

Conclusion and Relevance: Pneumatic retinopexy with air was a simple and inexpensive operation with less complication. If the eye had one of the two factors most predictive of failure (hyper myopia and visible traction gaping a tear), vitrectomy or scleral buckling was a better choice.

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Correspondence:
Chaopeng Li, Department of Ophthalmology, The Affiliated Huaian No.1 People's Hospital, Nanjing Medical University, 6 Beijing North Road, Huaian, Jiangsu, China, Tel: 86-0517-80872120;
E-mail: lcpcn@163.com

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Introduction

Rhegmatogenous Retinal Detachment (RRD) is a severe eye disease involving loss of vision, with an incidence that has been increasing with increasing numbers of cataract surgeries and the aging population. The main treatments to repair retinal detachment currently include scleral buckling, Pneumatic Retinopexy (PR), and Pars Plan a Vitrectomy (PPV). Although the most popular current method worldwide involves PPV, PR remains attractive because of numerous advantages, including simplicity, minimal invasion, lower risk of refractive changes and cataract formation, and lower cost [1-3]. And besides, PR can be performed in a procedure room avoiding delay. So, in many cases, PR could be used as a first-line treatment for uncomplicated RRD with one break or multiple breaks within 1 clock-hour of each other occurring in the superior 8 clock-hours of the retina [4,5]. In 1986, Hilton and Grizzard first reported a cure percentage of 84% of Retinal Detachments (RDs) using PR with expanding gases Sulfur Hexafluoride (SF6) or perfluoropropane (C3F8) [6]. Further investigations have shown that the reattachment percentage of PR with expanding gases ranged from 63% to 90% [7-9]. Given the high cost of C3F8, which is not available or affordable in some developing countries or remote areas, air would be a reasonable option. In addition, previous studies have shown that expanding gas can induce biochemical and structural alterations in the vitreous [10-13]. These alterations could be sufficient to predispose the eye to Proliferative Vitreoretinopathy (PVR), epimacular membrane, and new retinal break formations [14,15]. To reduce the vitreous disturbance and decrease the incidence of postoperative complications, some surgeons have performed PR using air instead of expanding gas, and have reported that both gases have

comparable reattachment rates and visual recoveries [16-18]. In the present study, we performed PR using air to treat uncomplicated RD, and reviewed the preoperative characteristics of these patients. The aim was to determine whether there were preoperative characteristics that correlated with postoperative anatomical outcomes, and also to provide references for PR using air.

Methods

A retrospective study was performed on a consecutive series of 72 eyes with fresh primary RRDs treated by PR from December 2017 to June 2020 at the Affiliated Huaian No.1 People's Hospital of Nanjing Medical University, Huaian, China. This study followed the Helsinki Declaration and was approved by the Medical Ethics Committee of the Affiliated Huaian No.1 People's Hospital of Nanjing Medical University (Approval Number: YX-2021-112-01). Patients were only included if the anatomical outcomes were available at 6 months. The inclusion criteria were the following: Having a single break within 1 clock hour and in the superior eight clock hours of the retina; having no PVR; and being able to physically and mentally cooperate in postoperative head positioning. Patients with ocular media opacities or glaucoma were excluded from this study. The study followed the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Affiliated Huaian No.1 People's Hospital of Nanjing Medical University. All participants signed a written and informed consent. The surgery involved surface anesthesia. Before intravitreal air injection, an anterior chamber paracentesis was performed to remove 0.4 mL to 0.6 mL of aqueous fluid to lower the intraocular pressure. The filtered air (0.8 mL to 1.2 mL) was then injected into the vitreous cavity *via* pars plana (3 mm to 4 mm from the limbus) using a 30-gauge needle. Patients were immediately instructed to position their heads so that the air bubble could close the retinal breaks, and were then examined the next morning. Retinal laser photocoagulation to the closed hole and degeneration was administered 1 to 2 days after the air injection. The patients were treated with a topical steroid and a cycloplegic while maintaining their position until the bubble disappeared. The following preoperative characteristics were extracted from the medical records: Age; sex; duration of symptoms; refractive status; lens status; location and size of breaks; extent of the RD; and the presence or absence of a visible traction of the whole gap. Anatomical success was defined as no additional surgical intervention (scleral buckle, or/and vitrectomy) during the 6 months study period. The data were analyzed using SPSS statistical software for Windows, version 22 (SPSS, Chicago, IL, USA). Descriptive statistics were used for the patients' demographic characteristics such as age. Preoperational clinical characteristics were summarized using percentages. The chi-square exact test was used to compare the percentages of all independent groups. If an expected cell count was <5, Fisher's exact test was used. A value of $P < 0.05$ was considered statistically significant.

Results

A total of 72 patients were included in the study. The mean age was 41.78 ± 14.75 years, and 68.1% were male and 31.9% were female. PR with air achieved a single operation success of 66.7%, and a repeat PR success of 77.8%. Figure 1 shows the retinal attachment and laser spots. Regarding the preoperative characteristics, the male success rate was 73.5% and the female success rate was 87.0% (P=0.23). Patients with a duration of symptoms >7 days had a success rate of 68.6%, while those <7 days had an 86.5% success rate (P=0.09). Eyes with high myopia had a 40% success rate compared with 92.3% success rate in eyes without high myopia (P=0.000). Phakic eyes had a success rate of 74.5%, while pseudophakic eyes had a success rate of 84.0% (P=0.55). With respect to the size of the breaks, eyes with breaks >1 Papilla Disc (PD) had a 60.0% success rate and those with breaks <1 PD had an 84.6% success rate (P=0.40). The pre-equatorial breaks had a success rate of 83.0% compared with a success rate of 63.2.6% in eyes with poster-equatorial breaks (P=0.11). Eyes with retinal detachments in one quadrant had an 86.1% success rate, while eyes with detachments in more than one quadrant had a 69.4% success rate (P=0.16). When the gap of the retinal break had vitreous traction, the success rate was 26.7.5% *vs.* the others without vitreous traction with a success rate of 91.2% (P=0.00). Anatomical outcomes for each preoperative characteristic are shown in Table 1 and Figure 2. Anatomical outcomes were similar between males versus females, involving the duration of symptoms >7 days *vs.* those <7 days; phakic versus pseudophakic; breaks >1 PD *vs.* <1 PD; a pre-equatorial break versus poster-equatorial break; and retinal detachment in one quadrant *vs.* > one quadrant. Anatomical failure was predicted by high myopia and the presence of vitreous traction in the gap of the retinal break.

Table 1: Preoperative Characteristics and success rate (PD: Papilla Disc; RD: Retinal Detachment).

Presence of various preoperative characteristics	n (%)
Gender	
Male	49 (36, 73.5%)
Female	23 (20, 87.0%)
The duration of symptoms	
≤7 day	37 (32, 86.5%)
>7 day	35 (24, 68.6%)
High myopia	
Yes	20 (8, 40%)
No	52 (48, 92.3%)
Lens status	
Phakic	47 (35, 74.5%)
Pseudophakic	25 (21, 84%)
The size of break	
≤1PD	52 (44, 84.6%)
>1PD	20 (12, 60.0%)
Location of break	
Pre-equatorial	53 (44, 83%)
Poster-equatorial	19 (12, 63.2%)
Extent of RD	
In one quadrant	36 (31, 86.1%)
Greater than one quadrant	36 (25, 69.4%)
Visible traction of hole's gap	
Have	15 (4, 26.7%)
No	57 (52, 91.2%)

Discussion

In this study, we study was performed on a consecutive series of 72 patients with fresh primary RRDs who performed PR. The single-procedure anatomic success rate in our series was 66.7%, which is highly similar to 66.8% in previously report [19]. The total success

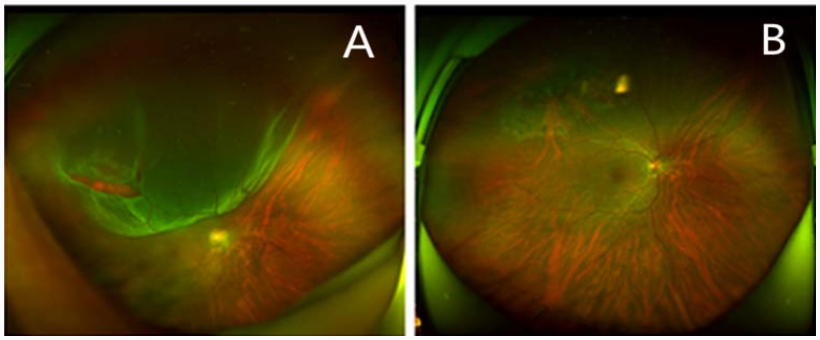

Figure 1: The ultra-wide field color photographs show retinal detachment before Pneumatic Retinopexy (PR), retinal attachment and laser scar with pigmentation around the retinal break after PR. A: retinal detachment before PR; B: 1 week after PR.

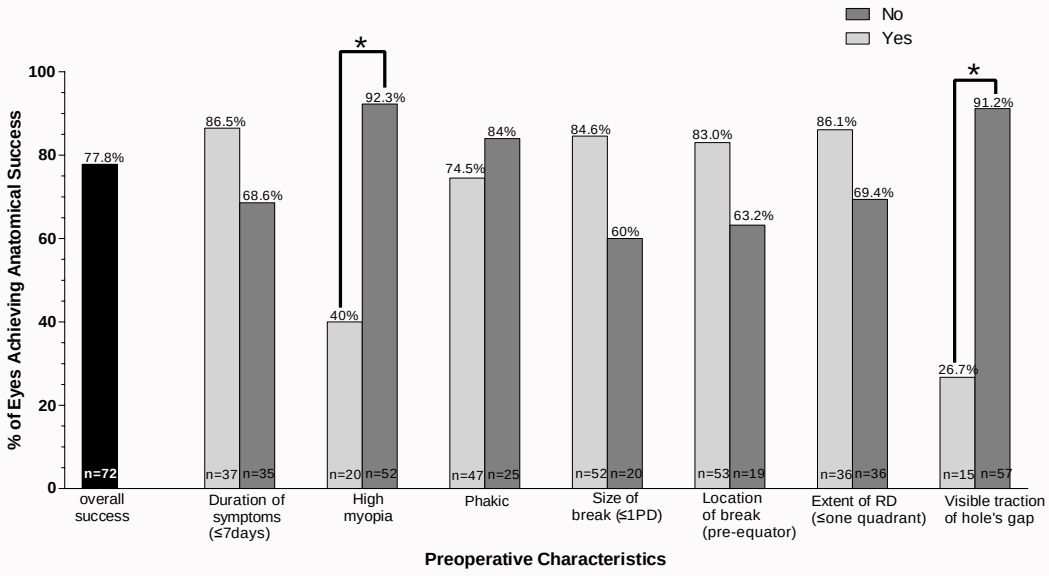

Figure 2: Overall anatomic outcome and anatomic outcomes of various preoperative characteristics. PD: Papilla Disc; RD: Retinal Detachment; *p<0.05.

rate of PR using air was 77.8%, which is comparable to rates in the former literature which ranged from 75% to 87% [20]. Studies have shown that PR for retinal reattachment using air is the same as using expanding gases. Compared to expanding gases, air results in minimal disturbance to vitreous bodies with few complications. Only six epimacular membrane cases and five new retinal break cases occurred in this study, and no PVR case occurred. In addition, the use of air is lower in cost and easy to obtain. At the same time, air as a short-acting gas persists in the vitreous cavity for 5 to 7 days, so its holding position time and visual rehabilitation could be shortened. In our study, there was no significant difference between male and female success rates. Grizzard in 1995 [21] and Kulkarni in 2007 [22] reported that male sex was a statistically significant factor in successful outcomes of PR. Both advocated that better patient education about adherence to positioning may eliminate this discrepancy. However, in a study by Davis in 2011, males and females had almost identical success. Perhaps the level of education of males and females is gradually getting closer with the progression of our society. The duration of symptoms had no impact on the success of PR. All retinal detachments in this series were diagnosed within 1 month. The size of breaks (1 PD *vs.* >1 PD) did not have an impact on the success rate of PR. In eyes >1 PD, there was a lower success rate (60.0% *vs.* 84.6%), but this was not statistically significant. As long as the position of the break was maintained at the pole after surgery, the location of breaks (pre- or posterior equator) had no effect on retinal reattachment. The smaller the extent of RD, the higher the success of PR, which may have been due to air in the vitreous cavity, which can provide relatively sufficient surface tension for the small extent of the RD. However, it should be noted that this factor also had no statistical significance. In studies of long-acting gas, it was found that pseudophakia was a negative factor [23-25], because the breaks in pseudophakic eyes were in the retinal periphery and were easy to miss. However, in the present study, it was found that retinal reattachment in pseudophakic eyes was higher than in phakic eyes, but it was not statistically significant. When a larger volume of anterior chamber fluid was removed in pseudophakic eyes than in phakic eyes, a space was created for a larger intravitreal air bubble, which securely blocked the retinal break and remained long enough in the eye to carry out its task. In addition, modern cataract surgery could also help identify these breaks by looking more clearly at the retinal periphery. Last but not least, we performed a meticulous preoperative examination to avoid missing the breaks in the retinal periphery before surgery. Gorovoy et al. [24] reported that high myopia had a minimal influence on the success of PR. However, in our study, high myopia was an independent risk factor. It was conceivable that the vitreous cavity was relatively large in high myopia patients, and surface

tension of air was relatively insufficient to press the retina against the retinal pigment epithelium. In addition, visible vitreous traction on retinal breaks was another risk factor, which may have been because the surface tension of air could not relieve the vitreous traction on the retinal break, so the break could not be closed. This result was consistent with previous results [2,26]. The major limitations of our study included its retrospective design, enrolling simple cases but not all types of RRD, and the small number of patients in some groups. Large randomized prospective studies enrolling a wide spectrum of RRD cases will therefore be needed in future studies.

Conclusion

PR with air was a simple and inexpensive operation with less complication. If the eye had one of the two factors most predictive of failure (hyper myopia and a visible traction gaping a tear), it would be better to select vitrectomy or scleral buckling. Eliminating these unfavorable factors, as well as careful preoperative examination, will therefore increase the success of PR using air.

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