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SUCCESSFULL PNEUMATIC RETINOPEXY FOR THE TREATMENT OF RHEGMATOGENOUS RETINAL DETACHMENT FOLLOWING BLUNT TRAUMA

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Abstract

***Introduction**: To report the successful single operative method using Pneumatic Retinopexy as management of rhegmatogenous retinal detachment following ocular blunt trauma.*

***Case Report**: A 17 years old boy admitted to clinic with blurred vision in lower part of right eye that worsen over time for 3 weeks with a history of blunt trauma. Initial examination showed the visual acuity of 6/6 on both eyes. Posterior segment evaluation revealed superior retinal detachment on right eye with macular sparing. The main retinal break located in superotemporal part. Patient then treated with Pneumatic Retinopexy using SF6 gas followed by a serial of laser demarcation on right eye. Three months follow up after procedure resulted in reattachment of retina with preserved visual acuity of 6/6 and reduced visual field defect on right eye.*

***Discussion**: Rhegmatogenous retinal detachment is the most common form of retinal detachment. Specific procedure of Pneumatic Retinopexy may vary based on expert preference respective surgery. However procedures should always include retinopexy, tamponade by gas and posturing of the patient.*

***Conclusion**: Pneumatic Retinopexy is a minimally invasive procedure that can be performed for the management of rhegmatogenous retinal detachment. In order to optimizing post operative outcome, ophthalmologists must be able to select suitable patient, proper examinations and good surgical techniques to achieve a high success rate.*

Keywords: Rhegmatogenous Retinal Detachment, Pneumatic Retinopexy

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INTRODUCTION

Retinal detachment (RD) is a condition where detachment of the inner layers of the retina serves as the neurosensory layer of retinal pigment layer or Retinal Pigment Epithelium (RPE). In addition to retinal artery occlusion, chemical eye trauma and endophthalmitis, RD is an emergency condition eyes that are often encountered and needed immediate treatment.[1] RD can classified as rhegmatogenous, tractional and exudative. The most common type is rhegmatogenous Retinal Detachment (RRD), which caused by the presence of fluid from the vitreous chamber that passes through the retinal break into potential space between the neurosensory layer of the retina and RPE.[2]

The incidence of RD varies between studies from 1:10,000 and other studies mention the incident between 6.3 to 17.9 per 100,000.[3] Men relatively have a higher risk of RD than women, and the risk of RD may be higher in Southeast Asian populations compared to the Europe where Southeast Asian populations tends to have a higher risk of myopia and the longer axial length of the eyeball.[3] The Rochester Epidemiology Project stated the annual incidence of RRD is 12.6 out of 100,000 in white skin population.[2] Study from Sultan et al. mentioned the incidence of global of RRD is about 1 of 10,000 population.[4]

The most important thing in managing RD is a good thorough inspection in preoperative and intraoperative. Break on the retina can be closed with several methods, where they aim to reattach the RPE and choroid with the detached retina for a sufficient period of long enough time to form chorioretinal adhesions which can completely close the subretinal space permanently. This process is generally carried out in 1 of 3 approaches; Pneumatic Retinopexy (PR), Scleral Buckling (SB), and primary vitrectomy with or without SB. In acute symptomatic cases with macula sparing the surgery should be carried out immediately.[2]

CASE REPORT

A 17 years old boy admitted to clinic with blurred vision in lower part of right eye that worsen over time with since 3 weeks earlier. Blurred vision of the bottom part seems to be blocked by curtain. The patient had no red, watery, or painful in his eyes. The patient had a history of blunt trauma because of elbow hit on the right eye 2 weeks before the symptom when he was playing with his brother. The first 5 days after the trauma he felt his vision is slightly blurred but it recovers spontaneously. No history of spectacle use, systemic disease and eye treatment.

The initial assessment revealed the visual acuity of the right eye was 6/6f and the left eye was 6/6. The other anterior segment examination were unremarkable. Funduscopic examination of the right eye revealed a retinal tear at 1 o'clock, RD in the superior area at 10-3 o'clock with macular sparing and bleeding in the peripapillary area. The examination also identify the lattice degeneration in the superior peripheral area at 2 o'clock and the inferior at 6 o'clock. The left eye fundus examination were within normal limits.

The Ultrasonography (USG) A-Scan examination of the right eye showed an image with medium-high spike in the posterior vitreous. B-Scan image revealed a continuous line with insertion on the optic nerve head that support the presence of RD. The perimetry of right eye showed the inferior arcuate scotoma of the right eye. The Visual Field Index (VFI) was of the left eye was 78%. The patient then assessed with RE RRD with grade B Proliferative Vitreoretinopathy and planned to be managed with PR with local anaesthesia in emergency operating

room. The procedure is planned right after the routine blood tests and antigen swab for covid screening since this case was found during COVID-19 pandemic.

The procedure of PR was done by injecting 0,5 cc sterile SF6 gas, after aqueous paracentesis of 0,2 cc from anterior chamber. The gas injected using 30 G needle in right eye from superotemporal part. After the injection, patient was observed to evaluate the intraocular pressure and the vascular of retina using indirect ophthalmoscope to see whether we found the sign of vascular occlusion. After procedure, patient was hospitalized and given the levofloxacin and artificial tears eyedrop along with oral analgetic. We also informed the patient about the importance of positioning the head face down for 10-14 days so that gas can help the reattachment process of neurosensory layer of the retina.

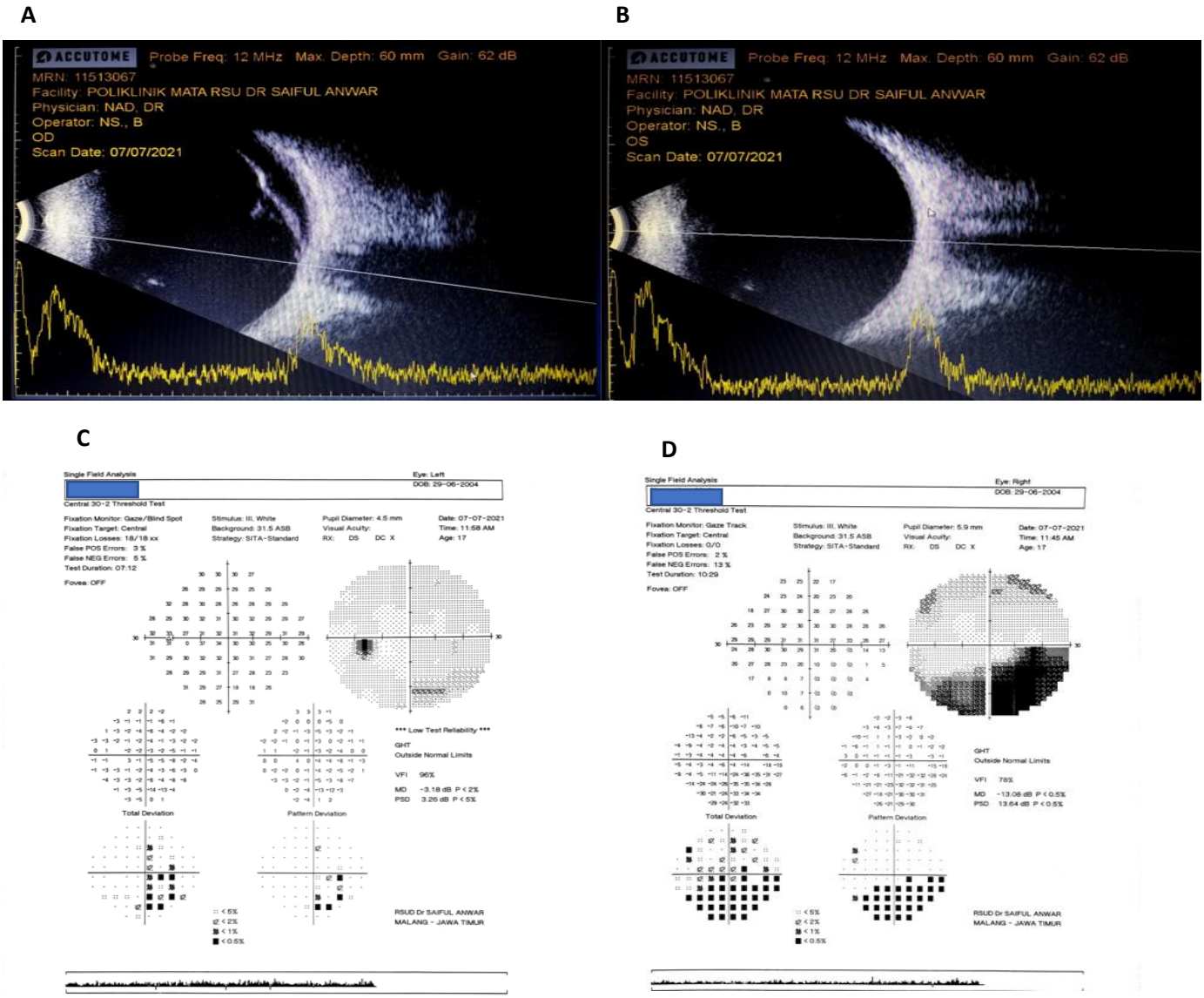

Figure 1. The USG and Perimetry on admission. The right eye USG showed a superior retinal detachment (A) and corresponding vision loss inferiorly on perimetry examination (D). The left eye USG (C) and perimetry (D) result were unremarkable.

During the hospitalization follow up, the visual acuity of right eye was 6/9 with 6/6 on pinhole, the left eye was 6/6. From the anterior segment of the right eye, we found a conjunctival and pericorneal injection with a minimal subconjungtival haemorrhage on the injection site. The IOP of the right eye was 18.9 mmHg. The posterior segment revealed a partially attached retina with gas bubble. The left eye examination was unremarkable. The patient the undergone the laser demarcation treatment on the right eye on the first and second day of hospitalization. The patient discharged on the third day to continue the evaluation in outpatient clinic after 2 series of laser demarcation. The first laser was conducted in first day dan the second laser in second day after procedure.

First outpatient evaluation in fifth day after procedure, the visual acuity of both eyes were 6/6. The anterior segment were within normal. The posterior segment of the right eye were visualized clearly where the superior part is attached. The laser scar of prior demarcation is marked around the tear area. The USG of both eyes were normal. The patient then underwent the third demarcation procedure on the right eye, followed by the laser prophylactic treatment for the lattice degeneration of the right eye.

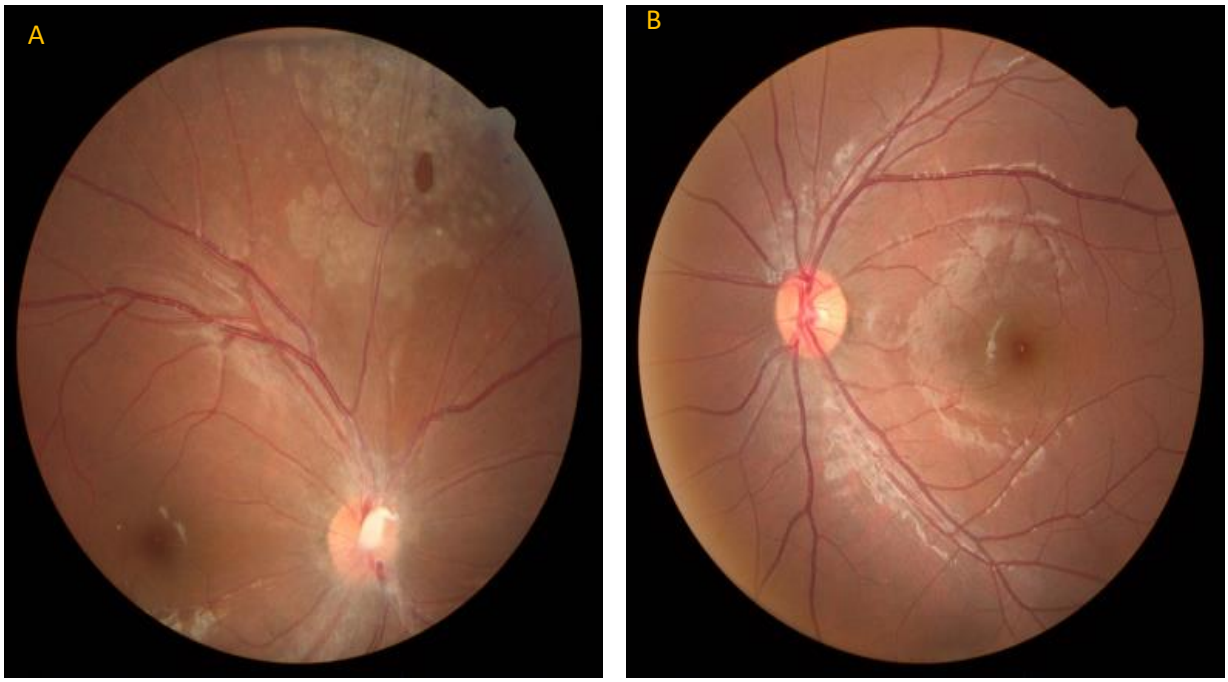

Figure 2. The fundus photograph on fifth day after PR procedure. The fundus of right eye (A) showed a reattachment of retina and tear located speriorly at 1 o'clock, surrounded by laser scar. The left eye (B) within normal limit.

First month after procedure, patient felt the vision of the lower part of his right eye were greatly improved with preserved visual acuity 6/6 on both eyes, with fully attached retina of the right eye on posterior segment evaluation. On the third month evaluation, the patient feels the blurred on the lower part of his right eye almost completely gone. The visual acuity was 6/6 on both eyes. The funduscopy examination showed an attached retina with dark laser scar marked around the tear at 1 o'clock. The USG of the right eye showed an attached retina. The perimetry examination resulted in residual visual field defect on inferotemporal part, where the VFI increased to 97%.

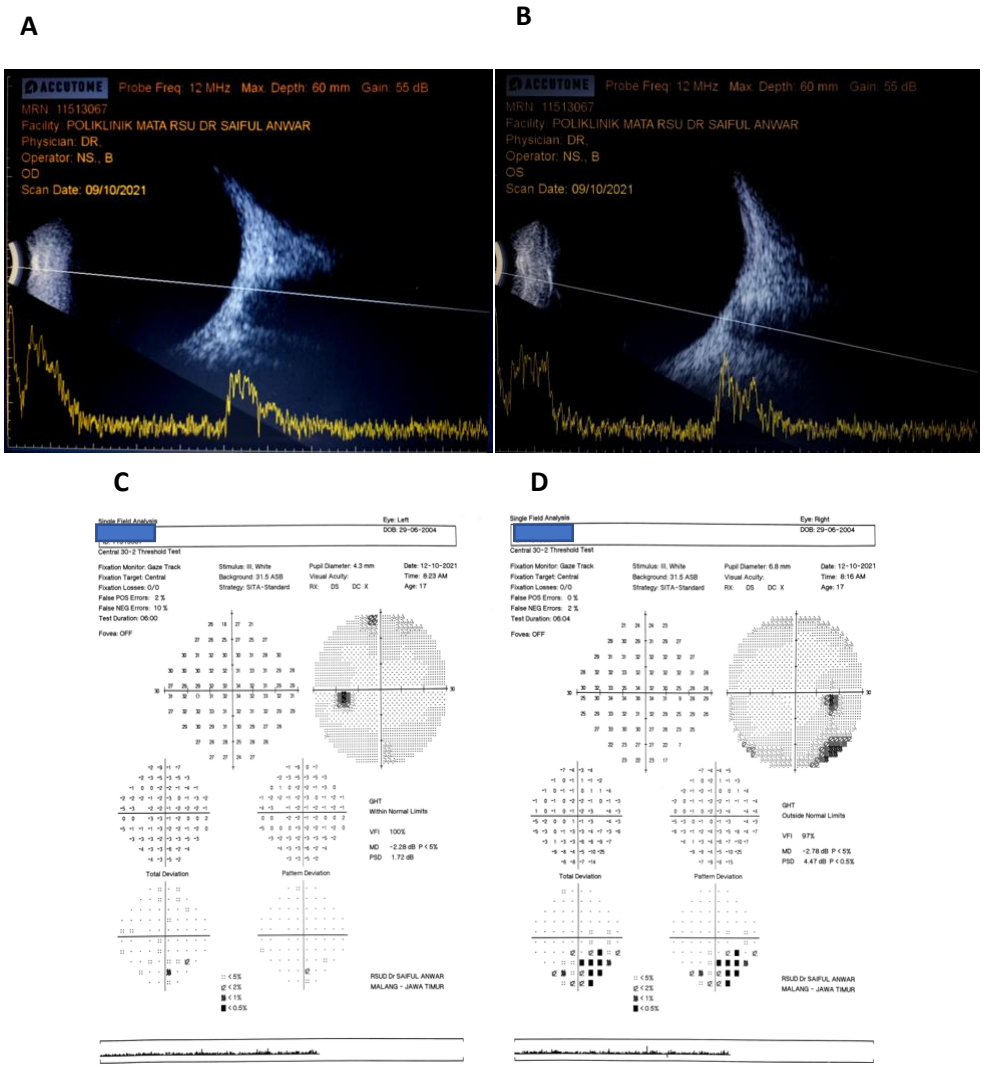

Figure 3. The USG and Perimetry on third month after procedure. The right eye USG revealed an attached retina(A) and perimetry showed an improvement of visual field in accordance to a successful procedure of PR (D). The left eye USG (C) and perimetry (D) within normal.

DISCUSSION

Risk factors for RRD are the myopia (where the axial length of the eyeball is higher), history of head or eye trauma, and the presence of vitreoretinal degeneration or dystrophy.[4,5] In patients with myopia above S-3 dioptres, the risk of RRD occurrence increased 10 times. This is important to consider amidst the increase of high myopia (more than S-6 dioptres) incidence worldwide, with a prevalence in school age children in Asia up to 80%. The Caucasian race and the Asian population have higher relative risk.[4] Most cases of RRD related to the tear that forms when the Posterior Vitreous Detachment (PVD) occurs especially in people that had of thinning of the retina previously, such as lattice degeneration.[5]

In 7%-8% of the normal population has an area lattice degeneration of the retina, however only a small part that develops to RRD.4 Patients with a history Cataract surgery can also increase the risk of RRD, especially if there was a rupture of posterior capsule and vitreous body loss.[4–6]

Although patients with younger age have a higher incidence of injury on the eyes compared to other age groups, only in a rare case where the RRD

occur immediately after blunt trauma because the vitreous in young age has not yet undergo the synchisis or liquefaction process. Therefore there is no fluid movement vitreous via tear or dialysis. However over time the vitreous can melts due to tear so liquid can enter the potential space and causes the neurosensory layer to peel off resulting in clinical manifestations of RRD generally start in later time. 12% of RRD occur immediately after trauma, whereas 30% occur within 1 month, 50% occur within 8 months and 80% occur within 24 months. RRD as a result from trauma in young patients can be shallow and frequently showing chronic signs such as multiple demarcation lines, subretinal deposits and intraretinal schisis.[2] In this case the symptoms occurred after 2 weeks after the trauma, where the asymptomatic period from trauma to the emergence of visual field defect can be caused by the vitreous that has not been liquefy in this patient.

Macular condition is a significant factor in determining patient's visual acuity outcomes and should be considered for the timing of operative management. Macular involvement or macula-off in RRD refers to the condition where fluid of the vitreous has entered the subfoveal space and potentially causing permanent damage that impact on the patient's visual acuity due to photoreceptor cell death and anoxia of the retina. The purpose of operative management in cases of RRD are to reattach the retina to improve visual acuity (in cases of macula-off) or to prevent decreased visual acuity (in cases of macula-on).[7]

The principle for the RRD examination is to find tears or breaks in the retina. Over 40 years, Lincoff and Giese have provided ideas that have been used widely known as Lincoff Rules for identifying main locations of tear on RRD, even though there are several cases of RRD that does not comply with this rule. In 90-95% of RRD cases, a primary tear can be found by the Lincoff Rule.[2,4] In this case, the main break can be found in the superonasal area of the right eye, where the detection performed according to the patient's clinical manifestation and using the second Lincoff rule principle, where detachment of the retina in the superior area which passes through the 12 o'clock meridian, on 93% case the primary break are found in 12 o'clock or within 1 ½ hours of that location. This principle can be used to determine the location of tears in RRD patients. Retinal breaks can be closed with several methods, where the main goal is to reattach the neurosensory part to the RPE and choroid for a sufficient time to form chorioretinal adhesions that will closes the subretinal space permanently.[2,4] This process is generally done by SB, Vitrectomy, or PR. In acute cases, macula-on accompanied by symptoms the surgery should be carried out immediately. On the contrary, eye with chronic RD with pigmented demarcation lines, the operative management can be postponed or not operated, if the eyes can be monitored continuously.[2]

PR is a minimal invasive, non-incisional procedure for the treatment of RD. This procedure relates to a reduced morbidity, costs and faster patient recovery compared to pars plana vitrectomy and SB. This procedure is carried out by injecting expandable gas and combine it with cryotherapy or laser photocoagulation to close the break on the retina. The satisfactory results can be achieved in suitable patient.[2,8] Repair technique of RD by retinopexy after gas tamponade first introduced by Rosengren in 1938, but this method was not yet known widely until 1986 by Hilton and Grizzard's where this technique was published in their seminal paper as the PR procedure as we know today.[8,9]

In the case of RRD the main indication of PR procedures are; when the examiner sure all the breaks in the retina are identified and located in the superior area within 4 to 8 o'clock; single or multiple break in the 1-2 clock-hour region; clear media; no grade C PVR; as well as the cooperative and capable patient that are able to maintain

the appropriate position after procedure.[2,9] Patients in this case is a suitable candidate for PR, where the location of the tear located superiorly at 1 o'clock, detached retina in superior area at 10-3 o'clock and no another break was found in the inferior retinal area, grade B PVR and also as the important consideration is the patient's condition is healthy and cooperative during the examination process.

evaluation of the peripheral retina is very important before surgical planning. Things that potentially complicate the surgery or failure such as media opacities, lattice degeneration or PVR should be noted.[8]

The SF6 gas and perfluoropropane (C3F8) generally chosen for tamponade. Gas bubble must be positioned precisely and lasts on the eyes for quite a long time to close breaks in the retina and help the

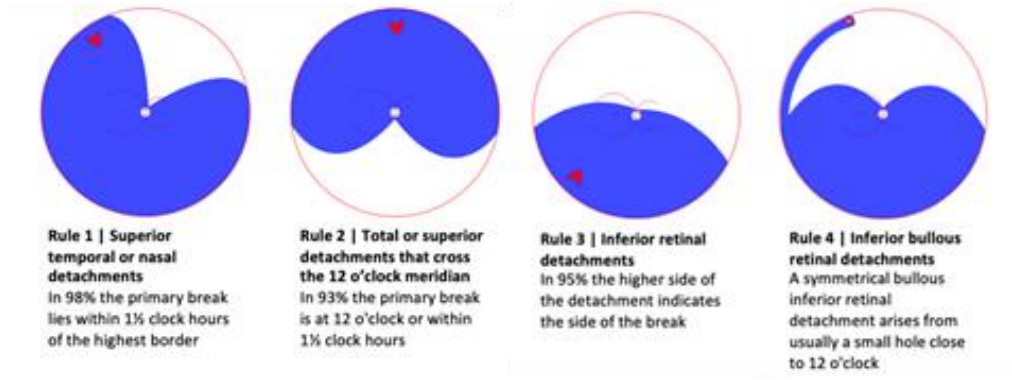

Figure 1. **The Lincoff Rule.**[4] This rule helps to identify the location of retinal break in RRD.

In patients with phakic eyes, the PR procedure tend to have a better result than pseudophakia or aphakia, where those eyes are more susceptible to experiencing small breaks in peripheral areas or on several quadrants that are often missed perioperatively.[8] This procedure contraindicated in RRD where break located at 4-8 o'clock inferiorly; media opacity that will difficulty to evaluate the retina and identifying the location of the tear; grade C or D PVR; retinal degeneration or wide traction; patients with glaucoma history; patients who cannot maintain the positioning after procedure; and patients who must travel to location with high altitude or by plane immediately after.[9]

Specific procedure of PR may vary based on expert preference. However, procedures should always include retinopexy, tamponade by gas and posturing of the patient. Careful preoperative examination, including slit lamp and scleral indentation for

resorption of subretinal fluid as the process of chorioretinal adhesion occurs. Pure SF6 gas lasts approximately for 2 weeks and expands 2 times in volume within 2 days, while pure C3F8 gas lasts approximately 6-8 weeks and expands 4 times within 4 days.[8,9] Filtered air is a type of gas that cannot expands and is generally absorbed deeply 3 days. This air is easier to get, cheaper but rarely used. Gas tamponade is injected perpendicularly through the pars plana, 3.5-4 mm from the limbus according to the patient's lens status with the volume of 0.2-0.3 cc for C3F8; 0.5-0.8 for SF6 and 0.8 cc for filtered air using a 27G or 30G needle in 1 cc syringe.[2,8,10,11] This case patient were given SF6 gas for injection because the gas can expand maximally in 48 hours so it is expected to help the apposition process faster. Gas that injected too quickly can cause the "fish eggs" phenomenon that require gentle tapping on the eyes or positioning the bubble away from break for 24 hours to provide time to fuse and avoid subretinal

gas. To avoid the "fish eggs", surgeon should withdraw the needle by 1 mm or three-quarter of the needle prior to the injection. Anterior chamber paracentesis to remove aqueous humour 0.1 to 0.25 cc is also an important step to do before gas injection to avoid IOP spike after injection.[8,9] In this case, we remove 0.2 cc of humor aqueous before gas injection.

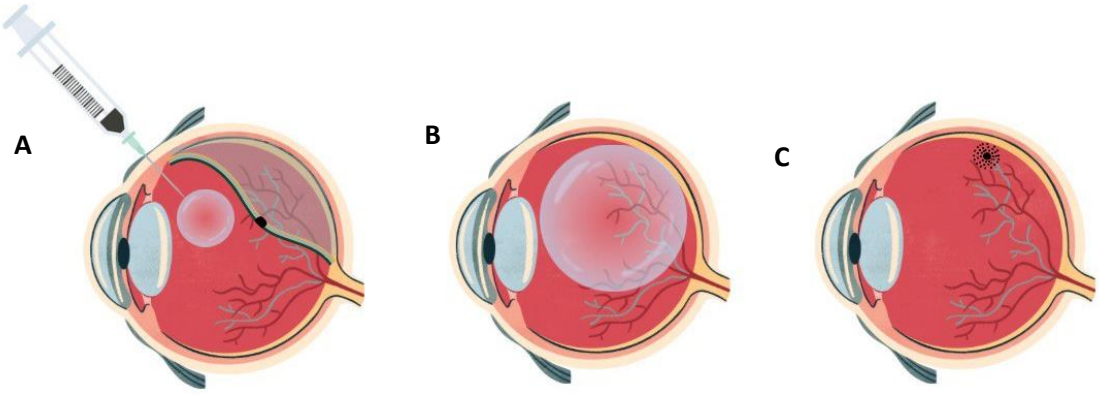

Figure 1. **The schematic of PR.** Gas bubble is injected into vitreous cavity (A), followed by the expansion of the gas to reattach the retina (B). The patient positioned so the gas can close the retinal break and help the resorption of subretinal fluid, followed by laser retinopexy (C).

The transconjunctival cryopexy can be performed in the PR procedure around the break area by visualizing using indirect binocular ophthalmoscope during procedure. Cryotherapy is chosen more often because it performed as a one-step procedure, easier for the break in peripheral areas and well-tolerated by the patient. Laser retinopexy can be used as an alternative to perform after retinal apposition 24-48 hours after gas injection, however the presence of gas bubbles can make the visualization of the retina during laser more difficult.[2,8] In this case the laser method is used to form a scar and performed 24 and 48 hours post-operative and also in first outpatient clinic follow up on the fifth day after procedure. The lattice degeneration that found in this patient were also given laser treatment in first outpatient clinic follow up. The asymptomatic patient with lattice degeneration usually does not require treatment. However, it is usually indicated in patient with additional risk factors such as RD in the fellow eye, flap tears, pseudophakia, or aphakia.[2] However, the patient was given as a prophylaxis due to the history of retinal detachment. There are still a lot of controversies on indications for prophylactic laser in peripheral degeneration. Despite of many publications, there is still no clear consensus for the indication for laser intervention that makes the decision for treatment also relied on the experience of the retina surgeon.[12]

Proper post-operative positioning is important to do. The patient must be able to position themself for 16-18 hours a day with 15 minutes break every hour for the first 5-7 days or 50% of the time every day for 2 weeks without supine position can help the gas bubbles gives a tamponade effect on breaks and restores the edge position on RPE so the adhesive scars can formed.[9,10] The patient's position in this case is face down due to the location of the tear located posterior to the equator at 1 o'clock. Complications that arise from PR including the increase of intraocular pressure, gas migration to subretinal or anterior chamber, endophthalmitis, cataracts and recurrent RD from the formation of

new breaks in the retina.[2] Complications related to increased pressure intraocular can be managed with anterior chamber paracentesis or with topical/systemic drugs to reduce the pressure. Evaluation of the patient during hospitalization and outpatient showed no signs complications after the PR.

When the retina fails to attach, the PR procedure can be reperformed or other the surgeon can consider different operative techniques such as SB or pars plana vitrectomy.[9] PR is called is considered fail when there is a lack of reattachment retina and/or the need for an intervention to reattach the retina within 6 weeks after PR procedure.[13] This can happen if there is an extension or re-opening of the main break that cause the detachment.[8] A review by Chan et al. in Stewart et al. from 81 studies involving 4183 eyes undergoing PR, the success level in 1 operation or single operation success (SOS) rate are 71- 84% in phakic and pseudo phakic eyes by 41-67%.[8] Higher success in the phakic eye can be caused by missed identification tears or the presence of new tears in the eyes pseudophakia and aphakia.[9]

In patients who experience failure and requires further procedure, the success rate up to 98- 99% can still be achieved. Therefore failure in primary PR doesn't have a negative impact on the further procedure.[4] When the macula has reattached perfectly, the patient can be evaluated every week for 2 weeks and every month for a period of 3 months.[9] The patient in this case is under follow-up post-operatively in 3 months and the success has been achieved marked by an improvement subjectively and objectively from ophthalmological examinations. In eyes with RRD especially with normal visual acuity without detachment of the fovea, the main complaint that arises is the visual field defect.[14] This is in accordance with the patient's condition since the beginning of the examination where there is no complaints of central vision. There is a visual field defect in the inferior part of the right eye can that can be caused by the presence of sub-retinal fluid that has not been absorbed or a part of peripheral retina that might be not completely attached. Research by Ooshiro and Iijima explained that light sensitivity on the retina that has reattached increased significantly after surgery but still not as good as the parts that doesn't experience detachment.[14] However, in patients with RD visual field disturbance is common to occur permanently or even the loss of central vision even though the retina has been reattached perfectly.[15] Informed consent and education to the patients to avoid the risk of re-detachment of the retina and early detection when complaints arise is important to maintain sharp vision and patient quality of life.

CONCLUSION

Pneumatic Retinopexy is a minimally invasive procedure that can be performed for the management of RRD. In order to optimizing post operative outcome, ophthalmologists must be able to select suitable patient, proper examinations and good surgical techniques to achieve a high success rate.

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