Research Article

Ophthalmology Research

Development of Novel Radial Relaxation Retinectomy Method on Retinal Detachment with Advanced Proliferative

Waldensius Girsang[1,3*], Sari DCR[1], Srigutomo Wahyu[2], Sasongko Muhammad Bayu[1] and Tjahyono D. Gondhowiardjo[3,4]

[1]FK-KMK, Gadjah Mada University, Bulaksumur, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta, Indonesia.

[2]Physics of Earth and Complex System, Bandung Institute of Technology, Jl. Ganesa 10 Bandung, Indonesia.

[3]Jakarta Eye Center, Jalan Teuku Cik Ditiro No.46, Menteng, RT.10/RW.5, Menteng, Kota Jakarta Pusat, Daerah Khusus Ibukota Jakarta, Indonesia.

[4]Indonesia University, Jl. Margonda Raya, Beji, Pondok Cina, Kota Depok, Jawa Barat, Indonesia.

[*]Correspondence:
Girsang, Waldensius, FK-KMK, Gadjah Mada University, Bulaksumur, Caturtunggal, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta, Indonesia, E-mail: waldensiusgirsang@gmail.com.

Received: 15 May 2018; **Accepted:** 26 June 2018

Citation: Waldensius Girsang, Sari DCR, Srigutomo Wahyu, et al. Development of Novel Radial Relaxation Retinectomy Method on Retinal Detachment with Advanced Proliferative. Ophthalmol Res. 2018; 1(1): 1-4.

ABSTRACT

Radial relaxation retinectomy followed by gas (C3F8 14%) tamponade usage has been applied to eyes experiencing retinal detachment accompanied by PVR of grade C1, C2, C3 and D1. In this method, geometrical boundaries of radial retinectomy are set up as to protect blood vessels, papil and macula. So far, out of totally 60 eyes who have received the treatment of this method, 2 eyes achieved 70% vision improvement, 4 eyes achieved 60%, 9 eyes achieved 50%, 16 eyes achived 40%, 14 eyes achieved 30%, 9 eyes achived 20%, and 6 eyes experienced 10% vision improvement. This new method provides an alternative relaxation retinectomy which is relatively fast and inexpensive and yields good results.

Keywords

Radial relaxation, Retinal detachment, Eye Center, PVR.

Introduction

PVR has been classified by The Retinal Society into grade A, B, C1, C2, C3, D1, D2, and D3 [1], based on the level of severity and its wide in the retina. Grade A PVR is the most minimal and grade D as the most chronic. As a general, surgery was done in retinal detachment with PVR grade C1, C2, C3, and D1 is vitrectomy with only silicone oil tamponade without retinectomy. This method of surgery is currently used in the most case of retinal detachment with higher grade C PVR. Unfortunately, this technique causes frequent side effects and re-detachment (20,55) because of the stretch of the remaining tissues [2]. Previous cases reported that the limitation of silicone oil tamponade method is associated with ocular hypotony (decreased intraocular pressure of 5 mm Hg or less) for 15,8% [2].

It also remains recurrent proliferation (epiretinal proliferation) 42,2%, increase of eyeball pressure 27,7%, lens turbidity 36,7% and corneal abnormalities 8,4% [3] after treatment. Based on empirical data of Jakarta Eye Center (JEC) on post-silicone oil-surgery patient, 18% of them got the ocular hypotony and 11% having ocular hypertension [4].

The silicon tamponade treatment would cost more because it also needs advanced surgery (as the second treatment) to remove the silicone oil. The high achievements of retinal detachment with PVR through retinectomy and considering many possible complications of silicone oil tamponade, lead the researcher to conduct another direct treatment. We urge to substitute silicone oil tamponade with gas tamponade in radial relaxation retinectomy for retinal detachment of grade C1, C2, C3 and D1 PVR. The radial relaxation retinectomy, in this case, is not the final treatment, but it is an initial step in coping retinal detachment with PVR grade C1, C2, C3, and D1. As an early treatment, the surgery would be faster

and more efficiently done. Wolffe [5], stated that light exposure from Endoilluminator used in the surgery had a photochemical effect which might damage the retinal cells (solar retinopathy). Gas tamponade 14% is enough to substitute silicone oil after relaxation retinectomy for retinal detachment with PVR. This gas tamponade will be slowly absorbed itself in 6 until 8 weeks without further surgery [6].

So far, there is no precise method or formula (geometrical formula) on cutting the retina (radial relaxation retinectomy) to put the retinal detachment with PVR back to retinal pigment epithelium. This formation made the detached retina get the nutrition and finally help increase the vision. The right basic of 2D radial geometrical retinectomy in this paper will be significant to formulate the accurate and comprehensive formula for cutting the retina.

Retinal Detachment with PVR

Proliferative vitreoretinopathy mostly occurs in the rhegmatogenous type of retinal detachment [1]. The rhegmatogenous retinal detachment is retinal separation due to a crack or a hole in the retina [7]. The retinal tear between the sensory retina and retinal pigment, allows fluid to pass from the vitreous space into the subretinal space [8]. As general, the development of rhegmatogenous retinal detachment involves some factors, includes posterior vitreous, one or more retinal tears and fluid in the subretinal pass through the tears [7].

In the beginning, vitreous liquefaction occurs as the result of the degenerative process. This is commonly known as vitreous syneresis which initiates retinal tears and rhegmatogenous retinal detachment. Myopia might worsen the vitreous syneresis and further results in posterior vitreous detachment (PVD) which triggers tractions and tears in the retina. This retinal traction might also deteriorate because of retinal folds formation. This condition is familiar with a massive vitreous retraction (MVR) [8-10].

Further, the term massive periretinal proliferation (MPP) refers to the existence of ectopic cells proliferation in proliferative vitreoretinopathy. It is known that the defined ectopic cells came from retinal pigment epithelium and retinal glial cells which is migrated to vitreous. Those cells then change its morphology and proliferated. The international committee sponsored by Retina Society establish the standard terminology to cope with various terms regarding this disease. The standard term used currently is proliferative vitreoretinopathy [11,12].

Method

The Cartesian coordinate system with x and y- coordinates are used to define the exact position of a point in a plane. It is also employed to describe a curve line as well as two-dimensional (2D) surfaces [13].

The horizontal axis is labeled x, and the vertical axis is labeled y. In the three-dimensional (3D) coordinate system, another axis is added and often labeled by z-axis. The axis is orthogonal to one another and all are appendicular to each other. The intersection of the points is as the origin and labeled 0. Each axis has a unit length and each length is marked then forms a grid. To describe a particular point in 2D spaces, the x-value is written (absciss), followed by y-value (ordinate). Thus, it is always (x,y). Since two axes are perpendicular to each other, the xy plane is divided into four regions called quadrants as in Figure 2.46 which often numbered with Roman numeral I, II, III, and IV. According to the common convention, the four quadrants are ordered starting from the top right (quadrant I), circling counter-clockwise. In quadrant I, both coordinates (x and y) are positive. In quadrant III, both coordinates are negative and in quadrant IV, the x coordinate is positive while the y-value negative.

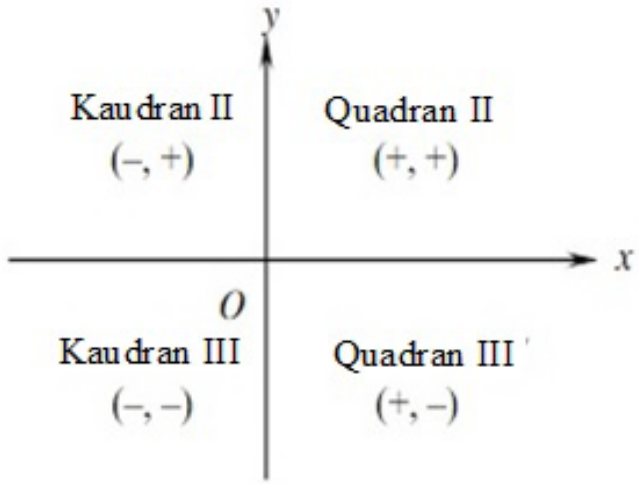

Figure 1: The Cartesian Coordinate System [13].

In contrast to the Cartesian coordinates which denote the points on x and y coordinate, the polar coordinates determine the position of a point based on an angle on positive x-axis and a distance from a reference point [14].

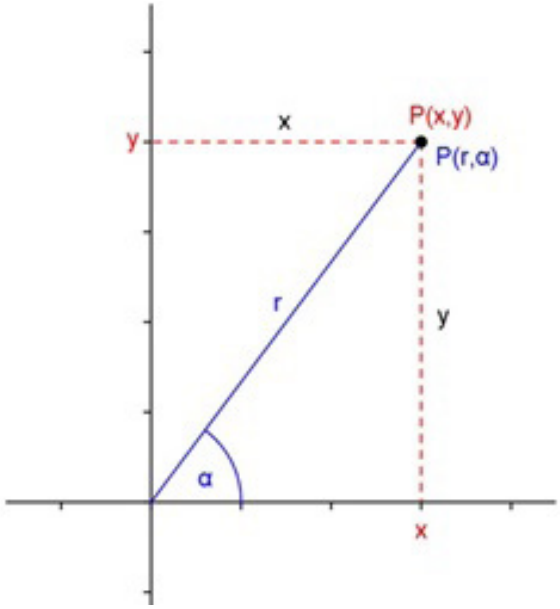

Figure 2: Delineation of polar coordinates.

On the chart above, the P-point is delineated in two coordinates,

the Cartesian coordinates (x, y) which indicate its relative position to x and y-axis, and the polar coordinates showing a distance to the 0 reference point and α angle formed by OP line segment to the positive x-axis.

Geometrically, 2D Cartesian and polar coordinates can be applied to the eyeball shown in figure below:

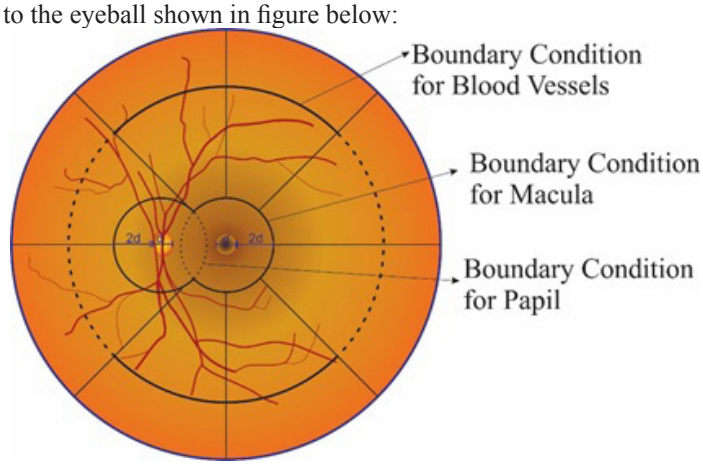

Figure 3. Cartesian and polar coordinates can be applied to the eyeball.

Our radial relaxation retinectomy that we perfomed uses the following limit specification (assuming boundary conditions) which are: Papil, In the papil region the boundary conditions are given due to the eye nerves that directly connected to the brain, the size of the boundary conditions that we apply is 3 times the diameter of papil from the center of papil which is 3 x 1.5 mm which we use as the radius of the condition boundary on papil. Macula, in the macula region the boundary conditions are given due to the important function of sharp vision. In the middle, there is a glossy patch of fovea, the amount of boundary conditions that we apply to the macula is 3 times the diameter which is 3 x 1.5 mm which we use as the radius of the condition limit on the macula. Blood vessels play an important role in blood distribution in the eye, so that the blood vessels we also apply boundary conditions of magnitude 2 times the radius of the boundary conditions on the macula, especially in quadrant I and II. It is intended that large blood vessels in the eye's nerves do not get cut off during retinectomy.

Result and Discussion

Practically researchers note that radial retinectomies is more effective since the absence of recurrent retinal detachment as the maximum relaxation and the tamponade used is also enough to consume gas. The problem to be concerned is the retinectomies would reach the posterior and cause bleeding or unwanted side effects. But, practically, radical relaxation retinectomy does not have to reach the posterior to trigger maximum relaxation. The previous information could be as the basis of descriptive study phase I, where the initial data began to be analyzed to determine the effectiveness of radial relaxation retinectomy. In details, the initial data of radial relaxation retinectomy surgery which has been done in 2015 and 2016 in patients with retina rhegmatogenous retina with PVR class C1, C2, C3 and D1 in 60 patients gave 58 anatomical successes with eyes successfully attached again and only 2 cases had recurrent retinal detachment. Based on further analysis it is known that 2 failed cases occurred because in the recovery process after surgery the patient did not follow the existing procedures, such as they should be more prone and minimize the heavy activity on the eyes. In these 2 cases of recurrent retinal detachment, repeated surgical results were performed until the final visus improved. The vision of successful operation showed the improvement of the highest vision function by 70% by 2 eyes, 60% by 4 eyes, 50% by 9 eyes, 40% counted 16 eyes, 30% counted 14 eyes, 20% counted 9 eyes and 10% 6 eyes, are fully shown in the following graph:

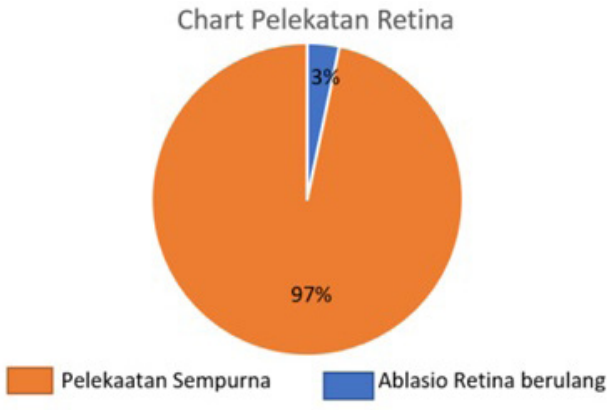

Figure 4: Percentage of Anatomical Attachment Repair after Surgery.

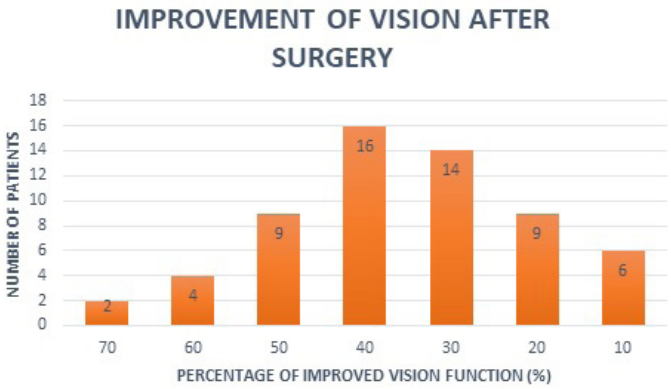

Figure 5: Graph of Comparison of the Number of Improved Vision Functions.

Conclusion

Novel retinectomy have been develop using radial relaxation retinectomy, we focused our research on retinal detachment with PVR grade C1, C2, C3, and D1, result of our operation showed the improvement of the highest vision function by 70% by 2 eyes, 60% by 4 eyes, 50% by 9 eyes, 40% counted 16 eyes, 30% counted 14 eyes, 20% counted 9 eyes and 10% 6 eyes. From that result we conclude that using radial relaxation retinectomy is faster, cheaper and the results will certainy be better. Faster is because after we finish doing vitrectomy, than we seen PVR, we immediately using radial retinectomy. Cheaper, because we don't need second operation to remove silicon oil from eyeball, because we only

used C3F8 14% gas as a tamponade. Beter because the operating manipulation of eye is minimal (no need to operate twice), and also avoids the possibility of toxic from the use of silicon oil on retinal cells.

References

1. Hilton G, Machemer R, Michels R, et al. The classification of retinal detachment with proliferative vitreoretinopathy. Ophthalmology. 1983; 90: 121-125.
2. Mendes TS, Gomes AMV, Rocha BS, et al. Evaluation of retinectomy in the treatment of severe proliferative vitreoretinopathy. Int J Retina Vitr. 2015; 1: 17.
3. Scholda C, Egger S, Lakits A, et al. Silicone oil removal: results, risks and complications. Acta Ophthalmol. Scand. 1997; 75: 695-699.
4. Desrina. 2017. Penelitian deskriptif: hasil dan tekanan intraokular pasien paska evakuasi silicon oil di Jakarta Eye Center periode tahun 2016. Jakarta: JEC.
5. Wolffe M. How safe is the light during ophthalmic diagnosis and surgery. Eye. 2016; 30: 186-188.
6. Papastavrou VT, Chatziralli I, McHugh D. Gas tamponade for retinectomy in PVR- related retinal detachmnet: a retrospective study. Ophthalmol Ther. 2017; 6: 161-166.
7. D'Amico DJ. Clinical practice: primary retinal detachment. N Eng J Med. 2008; 359: 2346- 2354.
8. Feltgen N, Walter P. Rhegmatogenous retinal detachment—an ophthalmologic emergency. Dtsch Ärztebl Int. 2014; 111: 12-22.
9. Sadaka A, Giuliari GP. Proliferative vitreoretinopathy: current and emerging treatments. Clin Ophthalmol Auckl NZ. 2012; 6: 1325-1333.
10. Pastor JC, Rojas J, Pastor-Idoate S, et al. Proliferative vitreoretinopathy: a new concept of disease pathogenesis and practical consequences. Prog Retin Eye Res. 2015; 51: 125-55.
11. Thompson JT. Proliferative Vitreoretinopathy. In: Retina. 3rd ed. St. Louis: Mosby, Inc. 2001; 2287-2314.
12. Campochiaro PA. Pathogenesis of Proliferative Vitreoretinopathy. In: Retina. 3rd ed. St. Louis: Mosby, Inc. 2001; 2221-2227.
13. Paul Ryclear, Giovani. Numerical integration of the cartesian equation of motion of a system constrain. Journal of Computational Physic. 1977; 23: 327-327.
14. Peak D, Inomata A. Summation over feynman histories in polar coordinat. Journal of matematical Physics. 1969; 10.