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Duration of rhegmatogenous retinal detachment predicts recovery of retinal sensitivity

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ABSTRACT

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The decision to treat a disease is often based on the presence or absence of symptoms, one prototype case being rhegmatogenous retinal detachment. Detachment of the neural retina from the pigment epithelium is a major cause of anatomical and functional dysfunction of the retina, where retinal recovery is inversely related to duration of detachment. The purpose of retinal reattachment is to effect recovery of the photoreceptors and pigment epithelium from degeneration. The aim of this study was to determine the critical duration of rhegmatogenous retinal detachment resulting in optimal retinal recovery after reattachment. A prospective study was conducted at a private hospital in Yogyakarta. Thirty five eyes were involved in this study. Three months after reattachment, central retinal recovery was measured by means of a Goldmann manual kinetic perimeter. The results showed that retinal recovery developed three months after surgery if the onset of rhegmatogenous retinal detachment was less than 28 days before surgery. The results were not significant if the onset of rhegmatogenous retinal detachment was more than 35 days. Although the Goldmann manual kinetic perimeter can efficiently detect central retinal sensitivity, it should be supported by more sensitive tools to evaluate the anatomy and function of the retina.

Keywords: Duration, rhegmatogenous retinal detachment, reattachment surgery, retinal sensitivity

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) is characterized by separation of the neural retina from the retinal pigment epithelium (RPE) with collection of fluid derived from liquefied vitreous gel through the retinal defect into the subretinal space.[1-3] This condition can lead to loss of vision especially when it involves the macula.[4-6] Untreated, RRD can lead to irreversible damages of the rods and cones, frequently ending in blindness.[7]

RRD leads to damage of the photoreceptors and retinal pigment epithelium (RPE),[8,9] where

the death of the photoreceptors is mediated by apoptosis.[6,10,11] All of these will lead to development of reactive changes in the inner retinal neurons and macro- and microglial cells, and prolonged retinal circulation times.[6,12,13] Therefore, retinal reattachment should be performed to reduce the effect of the metabolic and cellular changes.[8,14,15]

Successful anatomic reattachment is usually stable at the third month after retinal reattachment.[1,6] Unfortunately, it is not always followed by functional recovery. Although anatomic reattachment is successful, visual dysfunction and color vision defects may persist.[4,16,17] The visual dysfunction is affected by the duration of symptoms, the preoperative visual acuity, the type and extent of retinal detachment, and the involvement of the macula.[1,11,14] Therefore, there is a need for the detection of functional alterations in the retina after reattachment of the retina.[11,17]

There is no general consensus in identifying a critical period beyond which the prognosis for recovery dims.[6,18] In this study, we set out to determine the period of RRD before surgery which would still result in recovery of central retinal sensitivity after retinal reattachment.

METHODS

Research design

A prospective study was conducted at a private hospital in Yogyakarta from June 2007 to June 2008. The study was designed to evaluate whether the duration of rhegmatogenous retinal detachment before reattachment surgery would impact on the retinal sensitivity 3 months after successful anatomical retinal reattachment.

Research subjects

Thirty five eyes of 35 patients with primary RRD were involved in this study. All of them underwent retinal reattachment surgery between June 2007 to March 2008 at a private hospital in Yogyakarta. The inclusion criteria used to select patients for this study were: patients with primary rhegmatogenous retinal detachment with macular involvement, agreeing to have retinal reattachment surgery, and showing successful retinal reattachment 3 months after surgery. Exclusion criteria included retinal redetachment within 3 months after surgery, hereditary retinal disorders (retinitis pigmentosa), vascular retinal disorders (proliferative diabetic retinopathy), chorioretinal inflammation, and opacity of the refractive media. Drop-out was indicated if the patient did not return for follow-up at 3 months after surgery.

Data collection and measurements

The data were collected by anamnesis and ophthalmological examination. They included age, gender, duration of symptoms, location and extent of the retinal detachment, presence of proliferative vitreoretinopathy (PVR), type of retinal surgery, and central retinal sensitivity before and 3 months after retinal reattachment surgery. All of the subjects underwent retinal examination by indirect ophthalmoscopy. RRD was defined by the finding of a separation of the retina with associated hole or tear. The duration of the retinal detachment was calculated from the first day of visual complaints until the day of the retinal reattachment surgery. Central retinal sensitivity, expressed in isopters, was quantified by an ophthalmologist using the Goldmann manual kinetic perimeter. Recovery of retinal sensitivity was defined as increased retinal sensitivity 3 months after retinal reattachment.

Ethical clearance

Ethical clearance was approved by the Research Ethics Committee of the Dr. Yap Eye Hospital. All patients participating in this study gave their informed consent before surgery.

Statistical analysis

Regression analysis by means of SPSS 15.0 for Windows was used to evaluate the relationship between the duration of RRD before surgery and recovery of retinal sensitivity after successful anatomical reattachment.

RESULTS

Thirty five eyes of 35 patients were involved in this study. The patients consisted of 23 (65.7%) men and 12 (34.3%) women between the age of 20 and 60 years (mean age 44.4 ± 11.6 years). The duration of detachment ranged from 5 to 60 days with mean duration of 25.8 ± 9.2 days. Twenty five eyes had 2 quadrants of retinal detachment and the majority of the detachments was temporally located. All of the detachments involved the macula. Only 4 eyes demonstrated PVR, showing of scars of long-standing RRD. The subject characteristics are shown in Table 1.

Table 1. Characteristics of subjects

Characteristics	n
Gender	
Men	23 (65.7%)
Women	12 (34.3%)
Mean age ± SD (years)	44.4 ± 11.6
Mean duration of detachment ± SD (days)	25.8 ± 9.2
Extent of detachment	
2 quadrants	25 (71.4%)
3 quadrants	6 (17.1%)
4 quadrants	4 (11.4%)
Location of detachment	
Temporal	16 (45.7%)
Inferior	10 (28.5%)
Superior	5 (14.3%)
Total	4 (11.4%)
PVR	
No	31 (88.6%)
Yes	4 (11.4%)

Note: SD = standard deviation; PVR = Proliferative Vitreoretinopathy

Table 2. Types of retinal surger

Retinal surgery	n (%)
SB	2 (5.7)
SB + vitrectomy + gas	29 (82.9)
SB + vitrectomy + SO	1 (2.9)
SB + vitrectomy + gas + retinotomy	2 (5.7)
SB + vitrectomy + gas + ILM peeling	1 (2.9)

Note: SB = scleral buckling; SO = silicone oil; ILM = internal limiting membrane

Table 2 lists the types of retinal surgery performed in the subjects. The type of retinal surgery chosen depended on the condition of the retinal detachment before surgery. Twenty nine eyes (82.9%) underwent vitrectomy in combination with scleral buckling and gas tamponade, whilst the other eyes were treated with either scleral buckling alone or vitrectomy combined with gas tamponade, with or without another procedure. All of the surgery was conducted by a single retinal surgeon. No retinal redetachment was found during follow-up.

Three months after successful anatomical reattachment, the subjects were examined for retinal sensitivity. The mean sensitivity of the central retina 3 months after surgery (28.5 ± 3.7 dB) was higher than before surgery (19.8 ± 5.7 dB).

Table 3 reveals that the recovery of central retinal sensitivity was not significantly different in subjects who suffered from RRD for 35 days or less (p=0.465) compared with the groups of 14 days (p=0.021), 21 days (p=0.011), and 28 days (p=0.047).

DISCUSSION

The present study provides an evaluation of macular RRD. It has been suggested that retinal detachment involving the macula has more functional impact than peripheral detachment.[1,6,18,19] The metabolic rate in the cells

Table 3. Regression analysis for predicting changes in central retinal sensitivity by duration of RRD

	n	β	p
RRD ≤ 14 days	10	-1.355	0.021
RRD ≤ 21 days	18	-0.581	0.011
RRD ≤ 28 days	22	-0.333	0.047
RRD ≤ 35 days	30	0.092	0.465

Note: RRD = rhegmatogenous retinal detachment

of the macula is the highest compared to any other cell in the body.[6,9,11] Detachment of this area will result in nutritional deprivation of the photoreceptors and may cause hypoxia and/or ischemia, leading to necrosis and apoptosis of retinal cells. In addition, retinal detachment causes changes in retinal blood supply, resulting in a prolonged retinal circulation time.[8,9,12] The local immune and inflammatory response represents a major causative factor for reactive changes in the retina after detachment.[6,13,14] Hypoxia of the photoreceptors is proportional to the duration of detachment, therefore retinal reattachment should be performed promptly to alleviate the hypoxia and prevent photoreceptor degeneration. The recovery of photoreceptors after macular detachment is limited and in how far the process is different from extra-macular detachment is still unclear.[1,6,11]

The results of this study show an improvement of retinal anatomy and central retinal sensitivity three months after surgery. Some factors contributing to retinal recovery in RRD are duration of retinal detachment, the height of macular detachment, the patient's age, previous macular disease or previously reduced visual acuity.[6,19-21] The mean duration of retinal detachment in this study was 25.8 ± 9.2 days. The duration of the retinal detachment before surgery was estimated by the symptoms of vision. The presence of macular detachment is known to produce disturbances in visual acuity, metamorphopsia, and color vision.[17,19] Because all our subjects had retinal detachments that involved the macula, the signs of visual dysfunction could be used as estimator when the macular detachment occurred for the first time, even though it could lead to bias due to subjective symptoms and difficulties of recall. In the present study, most of the patients had retinal surgery after 2 weeks of detachment, so the retinal recovery in this study was indicative of long-term rhegmatogenous retinal detachment (7 days or more). Degeneration of the photoreceptors in the outer segment generally occurs within 12 hours after retinal detachment, and the cones and rods are damaged within 24-72 hours. The degeneration and the peak of proliferation in the inner segments develop within 1-3 days after retinal detachment and decline slowly within several weeks and Müller cells grow 3 days after detachment.[6,13,14] In long-term retinal detachment (7 days or more), the proliferative response may induce the formation of multiple layers of cells whose polarity does not match that of the original monolayer.[6,12,14] Naturally, the results of this study would have been different with detachment of recent onset.

Several studies had reported that functional recovery of the retina was best evaluated in RRD of recent onset (less than 10 days).[13,21-23] The duration of detachment and the age of patients did not influence the anatomical success of subjects with recent onset RRD, but the height of the macular detachment did.[13,24] Patients were advised to undergo scleral buckling within 7 days

after RRD.[22,25] The present study demonstrates minimal retinal recovery if the onset of RRD was more than 35 days (5 weeks). This result is supported by others, in that the duration of macular detachment was not of prognostic value after 30 days, [19,21,23,26] which may be explained as follows. In experimental detachments of owls, monkeys, and cats, proliferation of the RPE occurs at very low levels after long-term detachment (12-24 months). In long-term detachments, disorganized lamellar debris is found in the subretinal space, affecting photoreceptor recovery. Hypertrophy of the Müller cells in the outer plexiform layer will produce glia scars in the subretinal space, leading to failure of photoreceptor regeneration after retinal reattachment.[6,8,10] However, there is still a chance for retinal recovery if there are a number of remaining and retained ciliary stalks along with a few rudimentary discs or membrane evaginations. This is a crucial point because the connecting cilium is essential for production of the outer segment. [6]

The Goldmann manual kinetic perimetry used to measure the central retinal sensitivity is very efficient in quantifying visual field defects and detecting the location of neurologic lesions but not optimal in quantifying the central retinal sensitivity compared to automated perimetry.[27,28] Some studies have demonstrated that multifocal electroretinography (mfERG) could detect functional recovery of the retina.[14,25,28] In long-term retinal detachment, the retinal function will decline not only in the detached areas of the retina, but also in the attached areas.[6,28,29] However, this was not found in studies of recent onset RRD; it seems that central retinal function can remain fairly unaffected in peripheral RRD for some time.[1,6,11]

In the present study, as optical coherence tomography was not performed, either before or after reattachment surgery, such data as the height of detachment, the presence of edema, and the condition of the borderline areas between detached and attached retina, were not available.[20,30]

CONCLUSION

Duration of RRD of less than 28 days leads to significant improvement in retinal sensitivity three months after reattachment. Further studies of retinal function using more sensitive instruments are necessary to evaluate any variables that may affect the retinal sensitivity after reattachment.

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