

# Surgical outcomes and prognostic factors following vitrectomy in acquired immune deficiency syndrome patients with cytomegalovirus retinitis-related retinal detachment

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## Abstract

To determine the surgical outcomes and prognostic factors of cytomegalovirus (CMV) retinitis-related retinal detachment (RD) in acquired immune deficiency syndrome (AIDS) patients following vitrectomy.

A retrospective charts review was carried out on AIDS patients who were diagnosed with CMV retinitis-related RD and treated with vitrectomy between 2002 and 2016. The main outcome measures were the rates of primary anatomical success and final visual acuity (VA) success defined as postoperative VA  $\geq 20/200$ . Kaplan–Meier curves on the time to retinal redetachment were performed. Multivariate logistic regression models based on a directed acyclic graph were used to identify independent factors associated with achieving VA success.

Forty five AIDS patients (52 eyes) were included. Over a mean follow-up period of 41.7 months, primary anatomical success was achieved in 44 eyes (84.6%) and VA success was achieved in 34 eyes (65.4%). Receiving highly active antiretroviral therapy (HAART) prior to RD (adjusted odds ratio [aOR]=4.9,  $P=.043$ ), better preoperative VA (aOR=4.3,  $P=.006$ ), undergoing vitrectomy within 3 months (aOR=6.7,  $P=.008$ ), absence of optic atrophy (aOR=58.1,  $P<.001$ ), and absence of retinal redetachment (aOR=38.1,  $P=.007$ ) increased the odds of achieving final VA success.

Vitrectomy provided favorable anatomical reattachment in AIDS patients with CMV retinitis-related RD. Majority of patients was able to retain functional vision postoperatively. The use of HAART and early vitrectomy increased the probability of achieving both anatomical and VA success.

**Abbreviations:** AIDS = acquired immune deficiency syndrome, aOR = adjusted odds ratio, cHR = crude hazard ratio, CME = cystoid macular edema, CMV = cytomegalovirus, DAG = directed acyclic graph, ETDRS = Early Treatment of Diabetic Retinopathy Study, HAART = highly active antiretroviral therapy, HIV = human immunodeficiency virus, LogMAR = logarithm of the minimal angle of resolution, LSOCA = The Longitudinal Study of the Ocular Complications of AIDS, PCR = Polymerase chain reaction, PPV = pars plana vitrectomy, PVR = proliferative vitreoretinopathy, RD = retinal detachment, re-RD = retinal redetachment, SO = silicone oil, SOR = silicone oil removal, VA = visual acuity.

**Keywords:** AIDS, cytomegalovirus retinitis, retinal detachment, visual acuity, vitrectomy

## 1. Introduction

Cytomegalovirus (CMV) retinitis is the most common ocular opportunistic infection and a major cause of blindness among patients with acquired immune deficiency syndrome (AIDS).<sup>[1]</sup>

Following CMV retinitis, retinal detachment (RD) frequently develops, and creates more visual morbidity in these patients.<sup>[2,3]</sup> With the advent of highly active antiretroviral therapy (HAART), the global incidence of CMV retinitis as well as RD related to CMV

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retinitis have significantly declined. Studies from the U.S reported the incidence of CMV-related RD decreased from 0.50/person-year (PY) in the era before HAART to 0.06/PY in HAART era.<sup>[4]</sup> Nevertheless, CMV retinitis and RD as a consequence remains a significant burden in resource-limited setting countries, including Thailand.<sup>[5]</sup> A recent prospective cohort study from Thailand reported an incidence rate of RD among patients with newly diagnosed CMV retinitis at 0.25/PY, much higher than that reported from the U.S.<sup>[6]</sup> Retinal detachment secondary to CMV poses several surgical challenges owing to their distinctive vitreoretinal pathological changes. Pars plana vitrectomy (PPV) with silicone oil (SO) tamponade has long been the most preferred treatment of CMV retinitis-related RD as it provides a high rate of anatomical reattachment of 70% to 90%.<sup>[7–15]</sup>

Data regarding outcomes following retinal reattachment surgery among human immunodeficiency virus (HIV) patients in Thailand and in other developing countries where HIV and CMV retinitis remain prevalent are limited.<sup>[16–21]</sup> We conducted this study to determine the surgical outcomes, in terms of both anatomical and visual acuity (VA), from a single tertiary center in southern Thailand where the vast majority of affected patients in the region were managed. Predictive factors associated with such outcomes were also investigated.

## 2. Methods

### 2.1. Study population

This retrospective study was approved by the Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC number 59-070-02-4). A retrospective chart review was carried out on AIDS patients diagnosed with CMV retinitis-related RD who underwent retinal reattachment surgery at Songklanagarind Hospital, a major tertiary center in southern Thailand, between January 2002 and December 2016. The diagnosis of CMV retinitis was made clinically by experienced ophthalmologists based on the typical appearance observed during fundus examination. The distinct manifestations were classified into the following 3 subtypes: confluent retinal necrosis with a variable amount of retinal hemorrhage developing mostly in the posterior retina (fulminant type), granular retinitis in the peripheral retina with limited or no retinal hemorrhage (granular type), and predominant retinal perivasculitis with some retinal necrosis (frosted-branch angiitis type).<sup>[22]</sup> Polymerase chain reaction (PCR) testing of the intraocular fluid was performed in cases where there were equivocal clinical findings. Patients >18 years of age were included. Eligible patients were required to have a follow-up period of at least 6 months after the primary surgery in the eyes that underwent PPV with gas tamponade and of at least 6 months after SO removal (SOR) in eyes that underwent PPV with SO tamponade. We excluded non-HIV patients with CMV retinitis-related RD, and patients with previous vitreoretinal surgery, penetrating ocular trauma, and follow-up <6 months. Patients were initially identified from the hospital database using the International Classification of Diseases-10 codes B20.2 and H33.0. Medical records of identified patients were subsequently reviewed including only those individuals that fulfilled the abovementioned criteria.

### 2.2. Data collection

Baseline characteristics, preoperative status, retinal reattachment surgery, and postoperative status were collected and comprised

of age, sex, laterality, CD4+ T-cell count, highly active antiretroviral therapy (HAART), immune recovery (IR) status, VA measured using the Early Treatment of Diabetic Retinopathy Study (ETDRS) chart with logarithm of the minimal angle of resolution (logMAR) transformed, zone and lesion size of CMV retinitis based on the standard classification system,<sup>[23]</sup> retinitis activity, and anti-CMV treatment. IR was defined as an increase in CD4+ T-cell counts to a level of  $\geq 100$  cells/ $\mu$ l. The surgical procedure details included refractive and lens status, type of PPV by instrument gauge size, tamponade agent, macula status, proliferative vitreoretinopathy (PVR) preoperatively, and length of time from RD diagnosis to surgery. For treatment of active CMV retinitis, our routine primary treatment involved repetitive intravitreal ganciclovir injections (2 mg/0.1 ml). During the induction phase, injections were administered once weekly. When the lesions subsided, they were administered once every 2 to 3 weeks.

### 2.3. Surgical technique

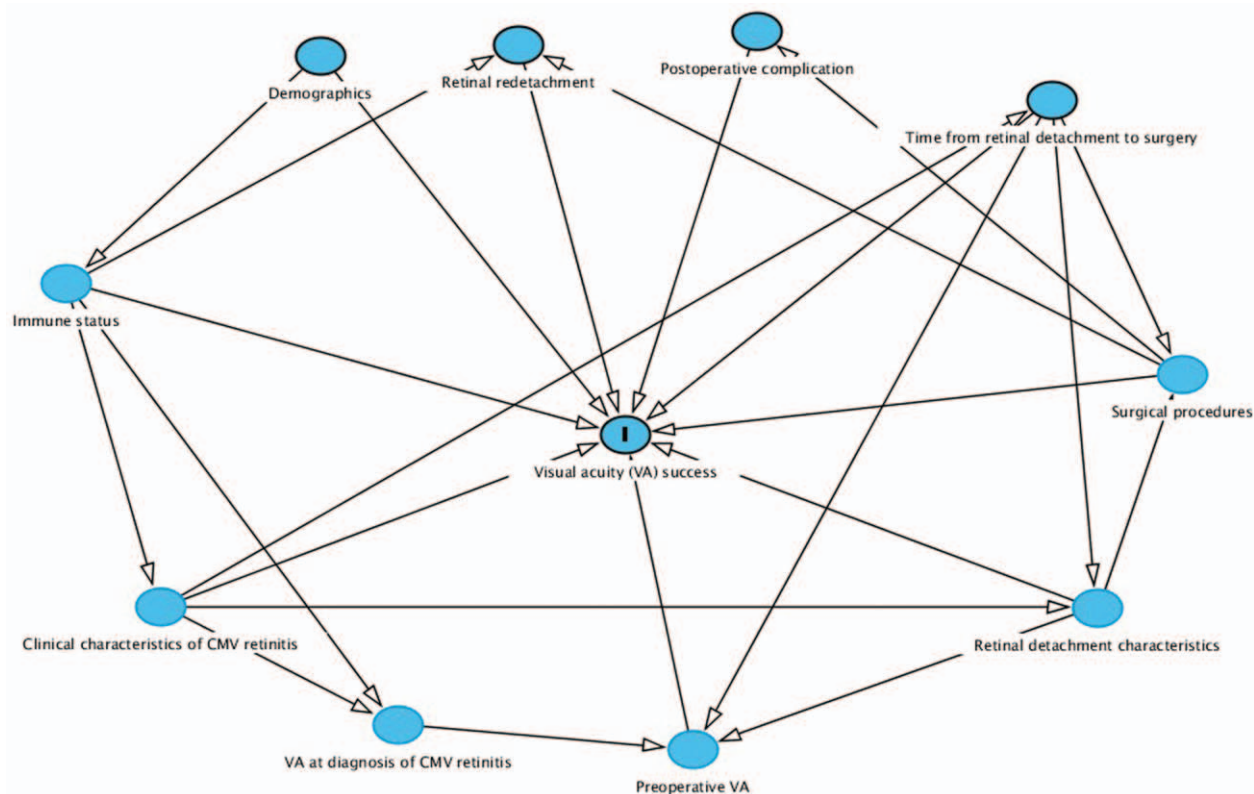
All surgical procedures were performed by one of 3 surgeons (P. J., P.B., and M.R.) using a similar technique. All eyes underwent a standard 3-port PPV with a complete core vitrectomy. Posterior vitreous detachment was then induced if it was not already present. Subretinal fluid was drained through air-fluid exchange. Retinopexy was performed by laser photocoagulation or cryopexy of all breaks. For intraocular tamponade, either 5000 centistokes of SO (Oxane 5700, Bausch and Lomb Inc., NY, USA) or 20% perfluoropropane (Ispan C<sub>3</sub>F<sub>8</sub>, Alcon Laboratories Inc., Texas, USA) was used at the discretion of the surgeon. Patients were advised to strictly maintain head positioning during the first postoperative month to ensure an adequate tamponade of retinal breaks.

### 2.4. Outcome measures

The primary outcome measure was primary anatomical success, defined as either complete retinal attachment or macular attachment observed from the dilated fundus examination at the final follow-up after primary surgery without reoperation. Anatomical outcome data were collected at every postoperative follow-up visit, typically at 1 week, or 1, 3, 6, and 12 months after surgery. The additional longer-term follow-ups that were available were included in the analysis. The secondary outcome was VA success, defined as an eye achieving a VA  $\geq 20/200$  at the final follow-up visit. Postoperative complications including ocular hypertension (>25 mm Hg), cataract ( $\geq$  grade 1), cystoid macular edema (CME), and optic atrophy were also recorded.

### 2.5. Statistical analysis

Descriptive statistics, including frequency, mean, standard deviation (SD), median, and interquartile range (IQR), were calculated. Kaplan–Meier curves on the time to retinal redetachment (re-RD) after primary surgery were constructed, and the log rank test was used for survival comparisons. The Fishers exact and Chi-Squared tests were used to compare the characteristics of eyes that achieved and did not achieve VA success. To determine factors associated with achieving VA success, a directed acyclic graph (DAG) using DAGitty Version 2.2 (Johannes Textor, Utrecht University, NL) that included all variables of interest was constructed to identify bias-minimized models. The potential



**Figure 1.** Theoretical model of the association between all variables of interest and visual acuity (VA) success based on a directed acyclic graph (DAG).

causal pathways between the variables and covariates were generated based on the understanding of the subject matter (Figure 1). Based on the assumptions described in the DAG, a minimal set of covariates was selected to investigate the total effect of each exposure on achieving final VA success. Multivariate logistic regression models based on the DAG were then performed. The model of each domain was refined by the method of backward elimination of variables within the domain not contributing significantly to the fit of model, guided by the change in the log likelihood of successive hierarchical models, retaining only those variables with a  $P$  value of  $<0.05$ . In the modeling process, missing values were accounted for using the method of covariate adjustment. All analyses were performed using STATA version 14 (StataCorp LP, College Station, TX, USA).

### 3. Results

#### 3.1. Demographic and clinical characteristics of study population

Ninety three eyes from 86 patients were diagnosed with CMV retinitis-related RD over the study period. Of these, 19 eyes were lost to follow-up after the diagnosis of RD, and 14 eyes did not undergo surgery owing to no light perception vision (6 eyes), total RD with widespread retinal/optic disc atrophy with  $>20/40$  VA in the other eye (4 eyes), and refusal to undergo surgery (4 eyes). Thus, a total of 60 eyes (53 patients) underwent retinal reattachment surgery. Eight of the 60 eyes were excluded, as follow-up time after primary surgery was  $<6$  months. Hence,

52 eyes (45 patients) were included in the study. The mean postoperative follow-up was  $41.7 \pm 29$  months (range 11–153 months), with 90%, 61%, and 52% of the eyes having at least 2-, 3-, and 4-year follow-ups, respectively.

The demographics, clinical characteristics, and RD characteristics of the 45 patients are summarized in Table 1. Approximately half of patients were male, and the mean age was 39 years (range 26–58 years). Approximately 73% of patients were receiving HAART at the time of their diagnosis with CMV retinitis; the median duration of HAART was 4 months (IQR 2.7–28.5 months). When RD developed, 39 patients (86.7%) were receiving HAART and had a median CD4<sup>+</sup> T-cell count of 152 cells/ $\mu$ l. Preoperative VA ranged from 20/25 to light perception. Of the 52 eyes, 36 (69.2%) presented with active CMV retinitis and had received intravitreal ganciclovir injections for various durations prior to RD development. PCR testing of the aqueous for detecting CMV was performed for 6 eyes owing to diagnostic uncertainty. These affected eyes had a high degree of media opacity, which precluded detailed fundus examination, and extensive retinitis that mimicked retinitis caused by other infectious organisms. The results of PCR were positive for CMV infection for all 6 eyes. The median duration from CMV retinitis diagnosis to RD was 5.5 months (IQR 1.6–33 months). The remaining 16 eyes presented with RD concurrent with old quiescent CMV retinitis. None of our patients received systemic anti-CMV treatment. Immune recovery uveitis was noted in 4 eyes before the onset of RD. All eyes underwent PPV alone without a scleral buckle. Four eyes (7.7%) had CMV retinitis lesions still active by the time of surgery. A 20-gauge PPV was performed in 47 eyes (90.4%); the remaining 5 eyes (9.6%)

**Table 1**  
**Demographic and characteristics of CMV retinitis and RD of 52 eyes (45 patients).**

Patient-specific characteristics	N=45 no (%), or Mean (SD)
Male	23 (51.1)
Female	22 (48.9)
Mean age, years	39.32 (8.05)
Bilateral CMV retinitis	31 (68.9)
Bilateral RD	7 (15.6)
Receiving HAART	
At CMV retinitis diagnosis	
Yes	33 (73.3)
No	10 (22.2)
Missing	2 (4.5)
At development of RD	
Yes	39 (86.7)
No	5 (11.1)
Missing	1 (2.2)
Immune recovery at CMV retinitis diagnosis	15 (33.3)
Eye-specific characteristics	N=52 no (%) or Median (IQR)
CD4 <sup>+</sup> T-cell count (cells/ $\mu$ l) at development of RD	
Median	152.0 (57.5, 428.5)
<50	11 (21.2)
50–99	3 (5.8)
$\geq$ 100	32 (61.5)
Missing	6 (11.5)
Immune recovery at development of RD	34 (65.4)
VA at preoperative RD	
> 20/50	9 (17.3)
20/50 to 20/160	15 (28.8)
20/200 or worse	28 (53.9)
Lens status	
Phakic	51 (98.1)
Pseudophakic	1 (1.9)
Area of CMV retinitis	
<25%	20 (38.5)
$\geq$ 25%	13 (25)
N/A	19 (36.5)
Zone-1 involvement of CMV retinitis	
Yes	16 (30.8)
No	17 (32.7)
N/A	19 (36.5)
Macula status of RD at operation	
On	15 (28.8)
Off	37 (71.2)
Presence of PVR	
Yes <sup>†</sup>	12 (23.1)
No	40 (76.9)
Active CMV retinitis at operation	4 (7.7)
Extent of subretinal fluid	
$\leq$ 1 quadrant	11 (21.2)
>1 quadrant	41 (78.8)
Vitrectomy type	
20-gauge	47 (90.4)
23-gauge	5 (9.6)
Tamponade agent	
Silicone oil	46 (88.5)
C3F8	6 (11.5)
Procedures in addition to vitrectomy	
Retinectomy	4 (7.7)
Lens removal	2 (3.8)

CMV = cytomegalovirus, RD = retinal detachment, HAART = highly active antiretroviral therapy, VA = visual acuity, PVR = proliferative vitreo-retinopathy

<sup>†</sup> Grade A = 1 eye, CP = 3 eyes, N/A = 8 eyes

underwent 23-gauge PPV. Primary tamponade with SO was used in 46 eyes (89%) and 20% perfluoropropane in the 6 remaining eyes (11%). The mean length of time from RD diagnosis to PPV was 3.1 months (range 0–32 months).

### 3.2. Anatomical outcomes

Primary anatomical success after primary PPV was achieved in 44 eyes (84.6%). Eight eyes (15.4%) developed re-RD. The Kaplan–Meier analysis estimated the cumulative incidence of re-RD at 1, 12, and 24 months after primary PPV to be 7.7% (95% CI: 3.0–19.2), 11.5% (95% CI: 5.4–23.9), and 13.5% (95% CI: 6.7–26.3), respectively (Fig. 2).

The relationship between demographics, clinical characteristics, surgical procedures, and incidence of re-RD is presented in Table 2. Univariate analyses demonstrated that the eyes of patients who were not receiving HAART when CMV retinitis was diagnosed (crude hazard ratio [cHR]=5.56,  $P=.02$ ), and the eyes that underwent PPV later than 3.1 months after the RD diagnosis (cHR=5.51,  $P=.02$ ) were at an increased risk of developing re-RD postoperatively. A multivariate analysis was not conducted owing to the small number of the events limiting the power to detect differences of association.

Of the 8 eyes that developed re-RD, 5 underwent reoperation by PPV with SO endotamponade. The other 3 eyes were not operated upon again due to poor visual potential. Three of the 5 eyes achieved anatomical success, with one reoperation at the final visit. Overall, final anatomical success was achieved in 47 (90.4%) of 52 eyes.

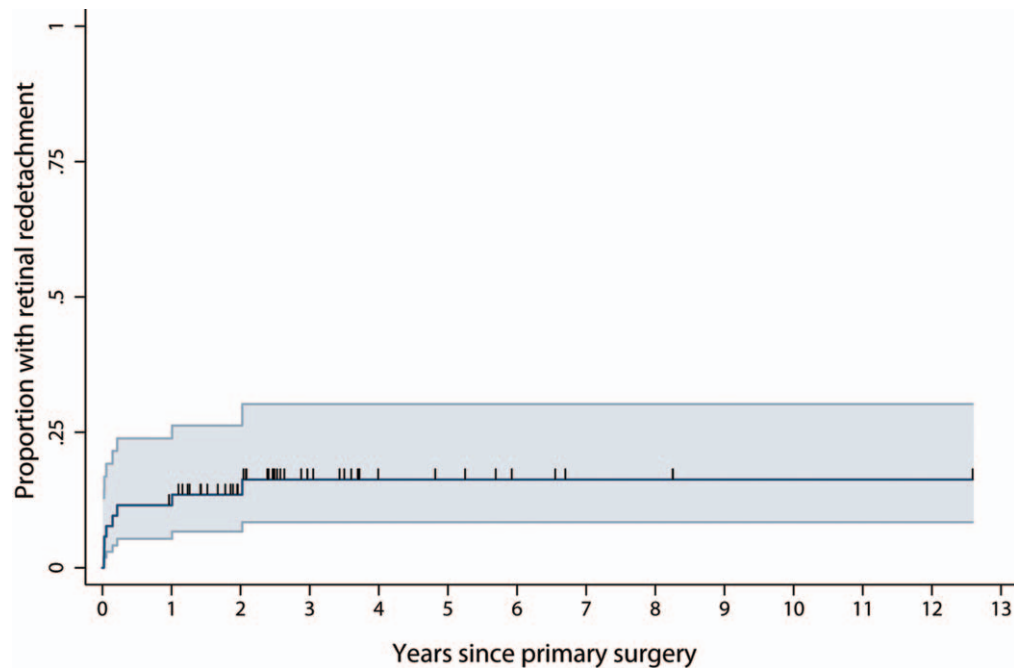
Of the 47 eyes that received SO tamponade, 44 (89.3%) underwent SOR after achieving stable retinal reattachment. The mean duration of the SO tamponade was  $12 \pm 3.7$  months (range 3–21 months). One of 44 eyes (2.3%) developed re-RD at 5 months after SOR. The SO tamponade was left permanently in 3 eyes due to severe RD with poor prognosis.

### 3.3. Visual acuity outcome

VA success at final follow-up was achieved in 34 eyes (65.4%). Fourteen eyes (26.9%) achieved a final VA of  $\geq$ 20/40. The final VA improved by  $\geq$ 2 lines in 24 eyes (46.2%), remained at the same level (within  $\pm$ 1 line) in 15 eyes (28.8%), and worsened by  $\geq$ 2 lines in 13 eyes (25%). The mean final logMAR VA was  $0.99 \pm 0.71$ , which improved from  $1.20 \pm 0.69$  preoperatively ( $P=.03$ , paired  $t$ -test).

The univariate analyses of variables associated with achieving final VA success are shown in Table 3. Eyes of patients who were receiving HAART at CMV retinitis diagnosis ( $P=.04$ ), with better presenting VA ( $P=.01$ ), with better preoperative VA ( $P=.004$ ), who underwent 20-gauge PPV ( $P=.04$ ), without retinectomy ( $P=.01$ ), who underwent PPV within 3.1 months ( $P=.01$ ), without postoperative optic atrophy ( $P<.001$ ), and without re-RD ( $P=.001$ ) were more likely to achieve final VA success.

Multivariate logistic regression analyses based on the DAG model were performed (Table 4). Significant predictors that remained associated with final VA success were: receiving HAART at the time of CMV retinitis diagnosis (adjusted odds ratio [aOR]=4.92,  $P=.04$ ), better presenting VA (aOR=2.94,  $P=.01$ ), better preoperative VA (aOR=4.25,  $P=.006$ ), undergoing PPV within 3.1 months (aOR=6.67,  $p=.008$ ), absence of optic atrophy (aOR=58.06,  $P<.001$ ), and absence of re-RD



**Figure 2.** Kaplan–Meier curve showing the overall cumulative incidence of retinal redetachment after primary PPV across time. Shaded areas represent 95% confidence intervals. From a total of 52 eyes followed up, 8 experienced retinal redetachment. Cross marks represent times of censoring.

(aOR=38.12,  $P=.007$ ). Type of intraocular tamponade and PPV gauge were not significantly associated with VA success. The total effect of retinectomy could not be estimated in the multivariate analysis owing to perfect predictions as shown in Table 3.

### 3.4. Postoperative complications

Cataract was the most common complication, accounting for 46 eyes (89%), followed by ocular hypertension/glaucoma (42%) and optic atrophy (19%). Cataract surgery was subsequently performed at a median time of 13 months after primary PPV in 40 eyes, of which 29 were combined with SOR. Epiretinal membrane (ERM), postoperative PVR, and CME were less commonly observed, accounting for 6%, 2%, and 2% of eyes, respectively. Serious complications, such as endophthalmitis or silicone oil-induced keratopathy, were not observed.

## 4. Discussion

The present study evaluated anatomical and VA outcomes following PPV with endotamponade in a population of AIDS patients with CMV retinitis-related RD in the HAART era. We observed that over the mean follow-up of 41.7 months, primary anatomical success after a single PPV without scleral bucking and postoperative VA success at final follow-up were achieved in 85% and 65% of eyes, respectively. This anatomical success rate is consistent with previously reported rates of 70% to 90% from Asia and sub-Saharan Africa.<sup>[15–20]</sup> The Kaplan–Meier curve indicated that the risk of re-RD was highest over the first 6 months after primary surgery. However, it could develop even after 2 years; hence, regular follow-up is still needed in this patient population. Our study observed that not receiving HAART by the time CMV retinitis was diagnosed, and the delayed PPV for greater than 3 months were associated with an

increased risk of re-RD, unlike the study reported from a tertiary center in northern Thailand.<sup>[17]</sup> They observed that only the presence of PVR preoperatively significantly correlated with re-RD. This discrepancy might be explained by the higher proportion of eyes with PVR grade C in their study compared to our study.

VA outcomes following retinal reattachment surgery reported in the literature are varied, partly due to inconsistencies in its definition and assessment. Generally, postoperative VA is less promising despite a successful anatomic reattachment. In the pre-HAART era, when follow-up time was limited owing to patients shorter life expectancy, most patients achieved good vision in the first few months postoperatively, but gradually experienced a decline in vision as the underlying CMV retinitis and optic atrophy progressed.<sup>[13,24,25]</sup> Since the late 1990s, VA outcomes have improved. The widespread use of HAART as well as surgical advances may have contributed to such better outcomes. Earlier studies conducted in the HAART era with follow-ups >6 months have reported postoperative ambulatory vision success rates varying between 50% to 65%,<sup>[14,15,17,20]</sup> which is comparable to the results of our study. A reason that our VA success rates is in the upper range may reflect that our study assessed VA after removing SO, reducing the effects of an altered refraction during SO tamponade. The mean logMAR VA before SOR was  $1.52 \pm 0.59$ , which subsequently improved to  $1.16 \pm 0.69$  at 6 months after SOR ( $P < .001$ , paired *t*-test). In addition, the relatively long follow-up time in our series allowed us to achieve VA after cataract surgery had been performed in the eyes developing significant cataract following PPV, further improving vision.

The Longitudinal Study of the Ocular Complications of AIDS (LSOCA) group demonstrated that the use of HAART has led to the marked improvements in the visual outcome of AIDS patients with CMV retinitis.<sup>[26,27]</sup> Our study provides additional evidence

**Table 2**  
**Incidence of and risk factors for the development of retinal redetachment following primary PPV.**

	n/N	Percentage of retinal redetachment after primary PPV by month			P value (Log-rank)	Crude hazard ratio (95% CI)	P value (Wald test)
		Month 1	Month 12	Month 24			
Overall rate	8/52	7.7	11.5	13.5			
Age (years)							
≤ 39	7/27	14.8	22.2	22.2	0.028	1	.06
> 39	1/25	0	4.0	4.0		0.14 (0.02, 1.05)	
Sex							
Male	2/26	0	3.8	7.7	0.124	1	.12
Female	6/26	15.4	19.2	19.2		3.28 (0.74, 14.56)	
Receiving HAART at CMV retinitis diagnosis							
Yes	3/37	2.7	8.2	8.2	0.012	1	.02
No	4/11	9.1	27.3	41.8		5.56 (1.39, 22.27)	
Immune recovery at CMV retinitis diagnosis							
Yes	3/15	6.7	20.0	20.0	0.633	1	.62
No	4/31	3.2	9.7	15.0		0.70 (0.16, 2.94)	
Area of CMV retinitis							
≥ 25%	3/14	7.1	14.3	25.0	0.328	1	.18
< 25%	1/9	5.3	5.3	5.3		0.23 (0.03, 1.98)	
Zone-1 involvement							
Yes	2/16	12.5	12.5	12.5	0.723	1	.87
No	2/17	5.9	5.9	5.9		0.85 (0.13, 5.66)	
Macula status at operation							
On	2/15	6.3	13.3	13.3	0.816	1	.81
Off	6/37	2.7	13.6	17.5		1.21 (0.26, 5.64)	
Presence of PVR							
Yes	1/12	8.2	8.2	8.2	0.462	1	.48
No	7/40	2.5	18.5	18.5		2.16 (0.25, 18.4)	
Preoperative CMV retinitis activity							
Active	1/4	25.0	25.0	25.0	0.535	1	.5
Inactive	7/48	6.3	10.4	12.6		0.52 (0.06, 4.35)	
Vitreotomy type							
20-gauge	7/47	8.5	12.8	12.8	0.725	1	.70
23-gauge	1/5	0	0	20		1.46 (0.22, 9.82)	
Tamponade agent							
Silicone oil	7/46	10.9	13.1	16.2	0.944	1	.93
C3F8	1/6	17.0	17.0	17.0		1.08 (0.21, 6.64)	
Retinectomy							
Yes	1/4	0	25.0	25.0	0.545	1	.54
No	7/48	8.3	10.4	12.6		0.53 (0.070, 3.99)	
Time from RD to surgery (months)							
≤3.1	3/38	2.6	5.3	8.9	0.009	1	.02
>3.1	5/14	7.1	35.7	35.7		5.51 (1.32, 23.02)	

CMV = cytomegalovirus, RD = retinal detachment, PPV = pars plana vitrectomy, HAART = highly active antiretroviral therapy, PVR = proliferative vitreo-retinopathy.

that in the subset of patients with CMV retinitis who developed RD and underwent surgery, receiving HAART at the time CMV retinitis was diagnosed was associated with better postoperative VA outcome. This finding is likely to be explained by the benefit of HAART in reducing retinitis progression and limiting retinal damage and VA loss prior to RD development.<sup>[3,28–30]</sup> HAART with subsequent IR could also prevent the relapse of CMV retinitis during the postoperative period thereby preventing further loss of VA. None of our patients experienced a CMV retinitis relapse postoperatively. IR was documented in 39 of 45 patients over the follow-up period. Apart from HAART, we found that eyes with better preoperative VA and VA at the time of CMV retinitis diagnosis correlated with a better VA outcome, similar to previous studies.<sup>[17,19,31,32]</sup> These findings stress the importance of early recognition and treatment of CMV retinitis for earlier detection and management of complications like RD.

Creation of a retinectomy was also significantly associated with poorer VA outcome in our study. Retinectomy procedure is generally required only in severe and complex RD cases. Hence, it could be assumed that cases which opted for this procedure represented complex cases and were likely to be associated with a poorer VA outcome.

Our study also showed that delayed surgery increases the risk of re-RD and is associated with a worse VA outcome. A high rate of loss to patient follow-up after RD diagnosis and the limited number of vitreoretinal surgeons at our center meant timely PPV was not always possible. Furthermore, patients with poor prognostic RD features in 1 eye but relatively good vision in the other eye may not have been prioritized for surgery compared to those appearing to have better prognoses. This issue may further confound the negative effect of delayed surgery. Other strong predictors of a poor VA outcome included the development of optic atrophy and

**Table 3****Comparison of achieving final postoperative VA success according to demographics, clinical characteristics, and operative procedures.**

Characteristics	Final postoperative VA		P value
	VA of < 20/200 no (%)	VA of ≥20/200 no (%)	
Age (years)			
≤39	10 (37.0)	17 (63.0)	.47
>39	8 (32.0)	17 (68.0)	
Sex			
Male	7 (26.9)	19 (73.1)	.19
Female	11 (42.3)	15 (57.7)	
Receiving HAART at CMV retinitis diagnosis			
No	7 (63.6)	4 (36.4)	.04
Yes	10 (27.0)	27 (73.0)	
Immune recovery at RD diagnosis			
Yes	11 (32.4)	23 (67.6)	.36
No	6 (42.9)	8 (57.1)	
Area of CMV retinitis involvement			
≥ 25%	5 (35.7)	9 (64.3)	.71
<25%	5 (26.3)	14 (73.7)	
Zone-1 involvement			
Yes	6 (37.5)	10 (62.5)	.47
No	4 (23.5)	13 (76.5)	
VA at diagnosis of CMV retinitis			
> 20/200	10 (25.6)	29 (74.4)	.01
20/200 to 5/200	1 (25.0)	3 (75.0)	
< 5/200	7 (77.8)	2 (22.2)	
Preoperative VA			
> 20/200	3 (13.0)	20 (87.0)	.004
20/200 to 5/200	1 (20.0)	4 (80.0)	
< 5/200	14 (58.3)	10 (41.7)	
Macula status of RD at operation			
On	4 (26.7)	11 (73.3)	.53
Off	14 (37.8)	23 (62.2)	
Presence of PVR			
Yes	6 (50.0)	6 (50.0)	.30
No	12 (30.0)	28 (70.0)	
Tamponade agent			
Silicone oil	17 (37.0)	29 (63.0)	.65
C3F8	1 (16.7)	5 (83.3)	
Vitrectomy type			
20-gauge	14 (29.8)	33 (70.2)	.04
23-gauge	4 (80.0)	1 (20.0)	
Retinectomy			
Yes	4 (100)	0 (0)	.01
No	14 (29.2)	34 (70.8)	
Time from RD to surgery (months)			
≤3.1	9 (23.7)	29 (76.3)	.01
>3.1	9 (64.3)	5 (35.7)	
Postoperative optic atrophy			
Yes	9 (90.0)	1 (10.0)	< .001
No	9 (21.4)	33 (78.6)	
Retinal redetachment			
Yes	7 (87.5)	1 (12.5)	.001
No	11 (25.0)	33 (75.0)	

VA = visual acuity, CMV = cytomegalovirus, RD = retinal detachment, PPV = pars plana vitrectomy, HAART = highly active antiretroviral therapy, PVR = proliferative vitreo-retinopathy.

re-RD. The causes of optic atrophy in these eyes are unclear; possibilities include primary optic neuropathy due to CMV, secondary effects of retinitis, and persistent RD.<sup>[2,5]</sup>

HAART improves survival of HIV infected patients. The removal of SO is therefore eventually required in patients who have undergone PPV with SO in order to improve vision and reduce long-term complications related to SO. Our study

demonstrated that SO could be safely removed from these eyes following successful reattachment. The re-RD rate following SOR was low at 2.3% over the median follow-up of 22 months (IQR 8–48 months). The result was a contradiction of a prior study published in 2005, which reported re-RD rate after SOR of 53% at median period of 4 months.<sup>[33]</sup> Their study occurred in a time where there were fewer resources to manage HIV/AIDS. The

**Table 4**  
**Multivariate logistic regression by robust estimation of predicting factors associated with achieving final VA success.**

Characteristics	Minimally sufficient adjustment set	Exposure variable: level	Final VA of $\geq 20/200$	
			Adjusted odds ratio (95% CI)	P value (Wald test)
Immune status - Receiving HAART at CMV retinitis diagnosis	- Demographics	No	1	.04
		Yes	4.92 (1.05, 23.13)	
VA at diagnosis of CMV retinitis	- CMV retinitis characteristics	< 5/200	1 <sup>a</sup>	.11
		20/200 –5/200	12.74 (0.54, 298.35) <sup>a,b</sup>	
		> 20/200	10.14 (1.59, 64.58) <sup>b</sup>	
		Trend	2.94 (1.28, 6.73)	
Preoperative VA	- RD characteristics - VA at CMV retinitis diagnosis - Time from RD diagnosis to surgery	< 5/200	1 <sup>a</sup>	.23
		20/200 –5/200	4.33 (0.16, 116.02) <sup>a,b</sup>	
		> 20/200	28.02 (2.27, 142.66) <sup>b</sup>	
		Trend	4.25 (1.53, 11.83)	
Time from RD diagnosis to surgery (months)	- CMV retinitis characteristics	> 3.1	1	.008
		$\leq 3.1$	6.67 (1.67, 25.0)	
Postoperative complication - Optic atrophy	- Surgical procedures	Yes	1	< .001
		No	58.06 (6.08, 553.73)	
Retinal redetachment	- Surgical procedures - Immune status	Yes	1	.007
		No	38.12 (2.66, 545.46)	

VA = visual acuity, HAART = highly active antiretroviral therapy, CMV = cytomegalovirus, RD = retinal detachment, PPV = pars plana vitrectomy.

The ab values in columns not having a superscript in common differ significantly ( $P < .05$ ).

Total effect of retinectomy could not be estimated owing to perfect prediction as shown in Table 4.

modern advances in HIV/AIDS patient management over the past 2 decades, including the use of modern HAART regimens, and an improved vitrectomy system, may have led to better outcomes in our study.

The limitations of this study include its retrospective nature and relatively small number of patients. Furthermore, 3 surgeons were involved in the surgeries, potentially confounding the surgical outcomes. However, all were experienced surgeons who performed the standard PPV techniques. The use of final VA as an outcome measure potentially led to biases in interpretation of results owing to varying follow-up times. Nevertheless, all patients had a minimum follow-up of 6 months and/or 6 months after SOR. We believe that this duration is suitable for visual rehabilitation and ascertaining surgical outcomes and complications. The lack of patients who received systemic antiviral therapy prior to RD development, precludes analysis regarding the effect of such treatment on the surgical outcomes. Our study also enrolled patients over a 15-year period. During this long period of time, there have been advances in vitrectomy technology as well as the transition to the microincision vitrectomy system, which potentially improved surgical performances as well as outcomes. Five eyes underwent 23-gauge PPV from 2010 onward. To account for the difference between 20- and 23-gauge vitrectomy, we analyzed the effects of PPV stratified by gauge on the outcomes, and the difference was not statistically significant. Further study with larger number of patients is warranted to determine definitive surgical outcomes in CMV retinitis-related RD patients undergoing this modern vitrectomy system. Other limitations apply, including the possibility of unrecognized confounders and uncertain generalizability of the findings to populations in other regions of Thailand.

In summary, our study provides evidence that PPV with a tamponade agent, as the treatment for AIDS patients with CMV retinitis-related RD, leads to favorable outcomes in anatomical reattachment. Indeed, following this surgical approach, visual acuity was either maintained or improved in approximately 75%

of the patients. Furthermore, using HAART by the time CMV retinitis was diagnosed, a better VA baseline and earlier surgical interventions appeared to increase surgical success. Hence, scaling up the access to HAART at an earlier stage of HIV infection, improving CMV retinitis screening capacity to detect retinitis earlier and provide prompt treatment, and a timely vitrectomy once RDs developed, could be strategic interventions to reduce blindness risks in this patient population.

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