# A novel classification of the vascular patterns of polypoidal choroidal vasculopathy and its relation to clinical outcomes

Article by: Colin SH Tan, Wei Kiong Ngo, Louis W Lim, Tock Han Lim
Poster by: Jarrod Chua, Melissa Hock, Rytus Lim

## Introduction

Polypoidal choroidal vasculopathy (PCV) is a form of age-related macular degeneration (AMD) that occurs more commonly in Asian populations. To date, there is no universally-accepted classification system for PCV. Traditionally, fluorescein angiography (FA) dye is not used due to early leakage of fluorescein from the choriocapillaris[1-3]. However, on observing vascular patterns on indocyanine green angiography (ICGA), some patients did not have severe leakage of FA, which appeared to influence long term visual outcomes. Therefore, we explored a possible novel classification system for PCV using ICGA and FA characteristics, and to compare clinical outcomes among PCV subtypes.

## Methods

This retrospective institution-based cohort study obtained data from 107 symptomatic PCV patients in Singapore. We propose a novel classification (shown in Figure 1) based on the nature of abnormal vasculature and the presence or absence of leakage from the lesion. Baseline investigations included a confocal scanning laser ophthalmoscope (CSLO) FA and ICGA using the Heidelburg retinal angiography, and sample results were recorded (Figure 2). These patients were then followed up by retinal specialists over 5 years, before visual outcome was accessed. Good visual outcome was defined as Visual Acuity (VA) ≥20/40, while moderate visual loss was defined as loss of ≥3 lines.

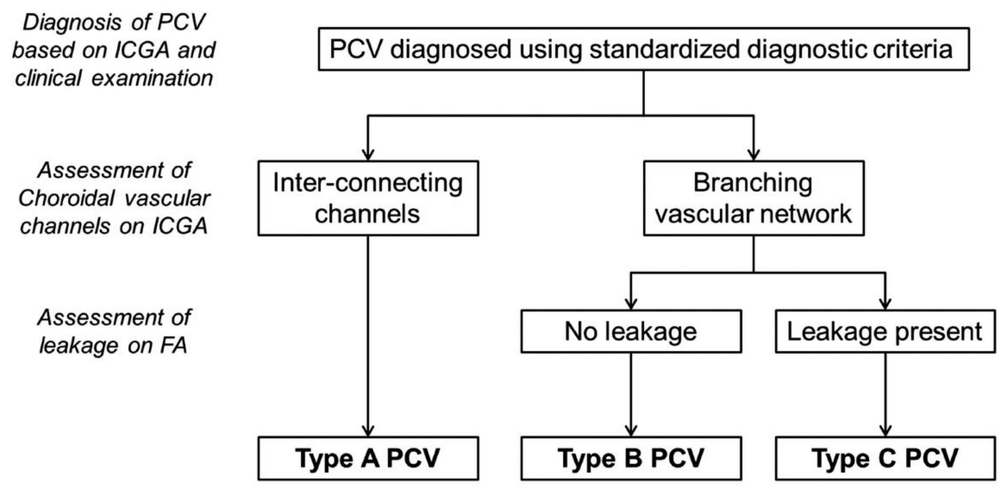


Figure 1: Classification system for polypoidal choroidal vasculopathy (PCV). ICGA -- Indocyanine green angiography. FA -- Fluorescein angiography

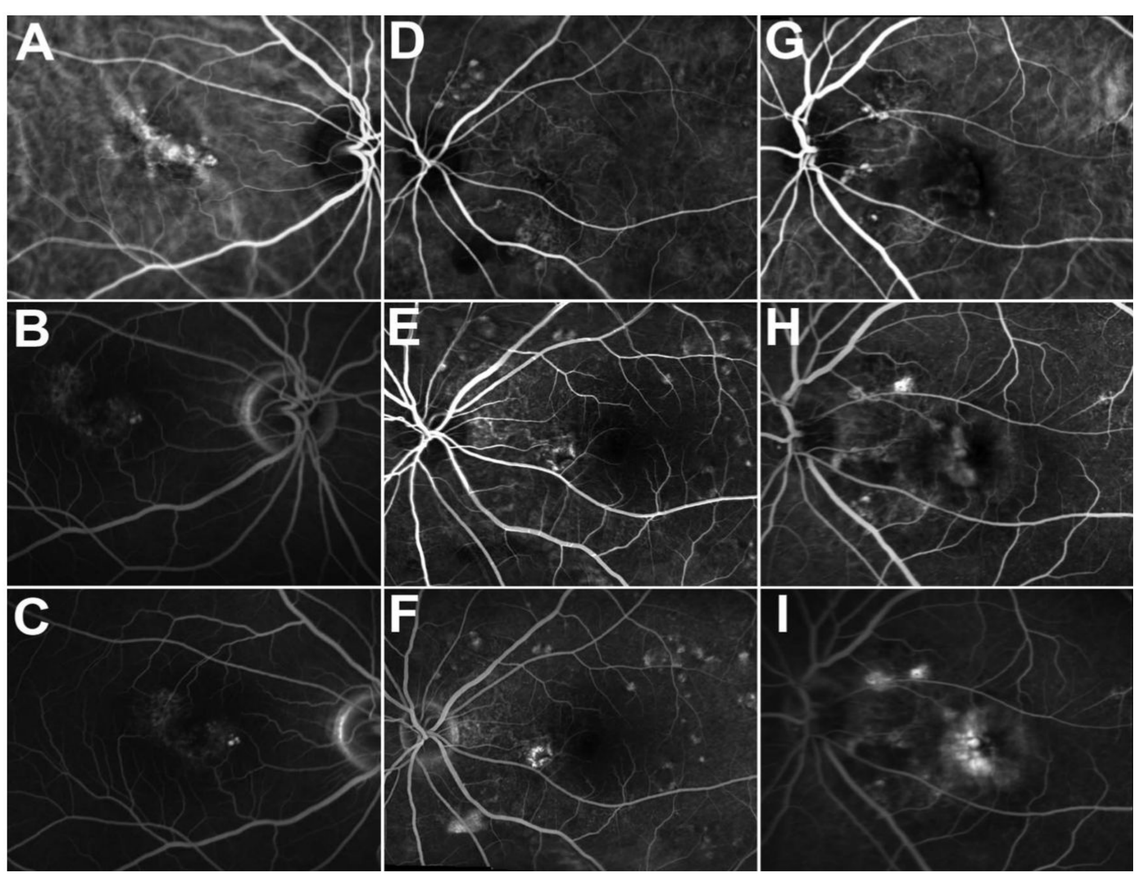


Figure 2: Subtypes of PCV, showing ICGA and FA stains. (A) Polyps and interconnecting channels to the fovea nasally. (B) Type A PCV with late FA showing pooling and retinal pigment RPE window defects. (C) Type A PCV, but in the absence of leakage. (D) Type B PCV with polyps peripherally to large branching vascular networks. (E) Type B PCV with early FA. (F) Type B PCV with late FA, without leakage. (G) Type C PCV showing polyps and a branching vascular network. (H) Type C PCV with early FA showing pooling. (I) Type C PCV with late FA showing leakage.

## Results

The most common diagnostic features of PCV were: nodular hyperfluorescence (95.3%), hypofluorescent halos around the nodule (81.3%) and branching vascular networks (77.6%). 24 patients (22.4%) were Type A, 26 (24.3%) were Type B and 57 (53.3%) were Type C. Table 1 shows the results.

**Table 1** Comparison of characteristic among the 3 PCV subgroups

| | Type A (n=24) | Type B (n=26) | Type C (n=57) | All cases (n=107) | p Value |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 15 (62.5) | 17 (65.4) | 35 (61.4) | 67 (62.6) | 0.941 |
| Female | 9 (37.5) | 9 (34.6) | 22 (38.6) | 40 (37.4) | |
| Age (years): mean (± SD) | 63.0 (12.8) | 64.6 (9.4) | 68.9 (9.0) | 66.6 (10.3) | 0.032 |
| Eye | | | | | |
| Right | 13 (54.2) | 11 (42.3) | 25 (43.9) | 49 (45.8) | 0.641 |
| Left | 11 (45.8) | 15 (57.7) | 32 (56.1) | 58 (54.2) | |
| Ethnicity | | | | | |
| Chinese | 22 (91.7) | 21 (80.8) | 50 (87.7) | 93 (86.7) | 0.489 |
| Malay | 2 (8.3) | 3 (11.5) | 6 (10.5) | 11 (10.3) | |
| Indian | 0 (0) | 2 (7.7) | 1 (1.8) | 3 (2.8) | |
| Lesion size ($mm^2$): mean (± SD) | 1.7 (1.7) | 5.6 (5.8) | 9.6 (9.5) | 6.9 (8.2) | <0.001 |
| Visual acuity (LogMAR units) | 0.22 (0.15) | 0.56 (0.45) | 0.73 (0.55) | 0.58 (0.51) | 0.001 |
| Total PDT treatment: mean (± SD) | 1.5 (0.76) | 2.6 (1.9) | 2.3 (1.5) | 2.3 (1.5) | 0.242 |

PCV, polypoidal choroidal vasculopathy; PDT, photodynamic therapy.

37.5% of all patients achieved good VA (≥20/40) at 5 years. Type A had the best visual outcomes, with 80-100% of patients achieving good VA over the 5-year period. Between 56.2% and 75% of patients with Type B maintained good VA. Between 7.7% and 22.2% of patients with Type C maintained good VA.

Over 5 years, recurrences occurred in 35.1% of patients, with recurrence rates varying according to subtype (Type A: 15.8%, Type B: 21.7%, Type C: 48.1%, p=0.078).

PCV subtype and age were significant factors for visual outcomes using multivariate analysis, which is depicted in Table 2.

**Table 2** Visual outcomes of the PCV subtypes over 5 years (macular location only)

| | Type A PCV (%) (n=19) | Type B PCV (%) (n=23) | Type C PCV (%) (n=52) | All cases (%) (n=94) | p Value |
|---|---|---|---|---|---|
| Good visual outcome (BCVA 20/40 or better) | | | | | |
| Start | 87.5 | 34.6 | 29.8 | 43.9 | <0.001 |
| 12 months | 94.7 | 56.5 | 19.2 | 43.6 | <0.001 |
| 24 months | 85.7 | 64.7 | 22.2 | 46.3 | <0.001 |
| 36 months | 84.6 | 56.2 | 18.2 | 41.9 | <0.001 |
| 48 months | 100.0 | 75.0 | 9.7 | 40.4 | <0.001 |
| 60 months | 80.0 | 66.7 | 7.7 | 37.5 | <0.001 |
| Loss of ≥ 3 lines of BCVA | | | | | |
| 12 months | 0 | 8.7 | 35.3 | 21.5 | 0.001 |
| 24 months | 7.1 | 23.5 | 41.7 | 29.9 | 0.046 |
| 36 months | 0 | 12.5 | 39.4 | 24.2 | 0.009 |
| 48 months | 0 | 0 | 48.4 | 28.8 | 0.001 |
| 60 months | 0 | 0 | 57.7 | 31.2 | <0.001 |

The results in this table are for the 94 PCV cases which were located at the macula (as defined in the manuscript) and excludes an additional 13 cases that were either peripapillary or extramacular.
BCVA, best-corrected visual acuity; PCV, polypoidal choroidal vasculopathy.

## Discussion

Standardized diagnostic and classification criteria are essential for better comparisons across studies and personalized patient management. The classification system facilitates patient stratification in clinical trials, enhances prognostic counseling, and informs personalized monitoring and treatment strategies based on subtype severity. It aids in predicting long-term outcomes, supporting both prognosis and the appropriate intensity of follow-up care. Future studies should focus on validating these findings prospectively and integrating the classification into clinical and research settings.

## Acknowledgements

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