Color Fundus Photography, Optical Coherence Tomography, and Fluorescein Angiography in Diagnosing Polypoidal Choroidal Vasculopathy

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• PURPOSE: To determine sensitivity and specificity of polypoidal choroidal vasculopathy (PCV) diagnosis using color fundus photography (CFP), optical coherence tomography (OCT), and fundus fluorescein angiography (FFA) without indocyanine green angiography (ICGA).
• DESIGN: Validity analysis.
• METHODS: Treatment-naïve eyes with serous/serosanguinous maculopathy undergoing CFP, OCT, FFA, and ICGA imaging before treatment at a university hospital in Thailand (January 1, 2013 to June 30, 2015) were identified. Images of each subject were categorized into 4 sets (set A: CFP; set B: CFP+OCT; set C: CFP+FFA; set D: CFP+OCT+FFA). Six graders, 3 from Thailand (PCV endemic area) and 3 from the United States (nonendemic area), individually reviewed each set (without ICGA), and determined if the presumed diagnosis was PCV. In parallel, 2 other graders confirmed if each case had PCV or not using EVEREST criteria (including ICGA). Sensitivity and specificity of a PCV diagnosis with each set (without ICGA) were analyzed compared with diagnoses including ICGA.
• RESULTS: Of 119 study eyes (113 subjects, 57% male, mean age ± SD 59.9 ± 13.8 years), definite PCV diagnosis was 40.3%. Sensitivity of sets A, B, C, D: 0.63 (95% confidence interval [CI]: 0.47–0.76), 0.83 (95% CI: 0.69–0.92), 0.54 (95% CI: 0.39–0.68), 0.67 (95% CI: 0.51–0.79); specificities: 0.93 (95% CI: 0.84–0.97), 0.83 (95% CI: 0.72–0.91), 0.97 (95% CI: 0.89–0.99), 0.92 (95% CI: 0.82–0.97); accuracies: 0.81 (95% CI: 0.73–0.88), 0.83 (95% CI: 0.76–0.90), 0.79 (95% CI: 0.73–0.87), 0.82 (95% CI: 0.74–0.88). Discrepancies between Thai and US graders existed through sets A, C, and D.
• CONCLUSIONS: These data suggest that without ICGA, fundus photography combined with OCT provides high sensitivity and high specificity to diagnose PCV; adding FFA does not improve accuracy. (Am J Ophthalmol 2018;192:77–83. © 2018 Elsevier Inc. All rights reserved.)

POLYPOIDAL CHOROIDAL VASCULOPATHY (PCV) IS AN important cause of central vision loss among individuals of African and Asian descent.[1–5] It is still controversial whether PCV is a subtype of neovascular age-related macular degeneration (NVAMD) or a different disease entity. The 2 conditions share similar presenting characteristics, including submacular fluid, exudates, or hemorrhage.[6–9] If left untreated, both can lead to permanent visual loss. However, it is important to differentiate PCV from typical NVAMD because their natural history, treatment response, and prognosis are different.

Indocyanine green angiography (ICGA), a vascular imaging technique that allows physicians to visualize choroidal vasculature and its abnormality, has been accepted as a gold standard to diagnose PCV.[9] The characteristics of PCV on ICGA include the presence of hyperfluorescent polypoidal vascular filling with or without branching vascular network (BVN).[10] Despite its advantages, ICGA is an invasive imaging procedure. It requires special dye and equipment, which are available only at large ophthalmic institutions. Moreover, ICGA is contraindicated in patients with impaired kidney or liver functions, those with history of allergy to iodine-based contrast dye, and those during pregnancy. Therefore, ICGA is not always a practical tool to assist physicians to diagnose PCV, especially those working in countries with limited resources, including Thailand.

In clinical practice, there are some clinical clues suggesting the diagnosis of PCV, including the presence of subretinal orange nodules or massive subretinal hemorrhage on

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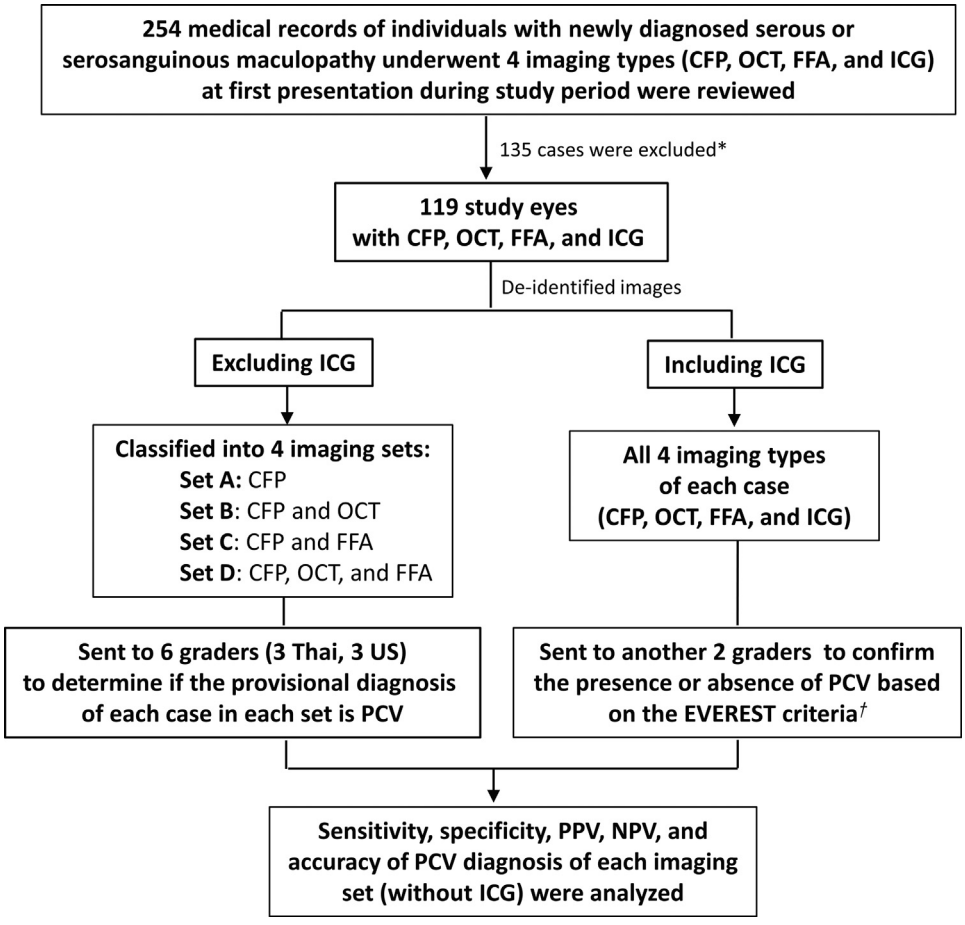

FIGURE 1. Flowchart of study methods. *A total of 135 cases were excluded owing to receiving previous treatments (88), poor image quality (20), incomplete imaging (missing 4 imaging types) (17), and presence of coexisting vision-threatening conditions (10). †The EVEREST criteria for polypoidal choroidal vasculopathy (PCV) diagnosis include the presence of indocyanine green angiography (ICGA) hyperfluorescence (appearing within the first 6 minutes of ICGA dye injection) and at least 1 of the following diagnostic criteria: nodular appearance of the polyp on stereoscopic viewing, hypofluorescent halo around the nodule, abnormal vascular channel(s) supplying the polyps, pulsatile filling of polyps, orange subretinal nodules corresponding to the hyperfluorescent area on ICGA, and massive submacular hemorrhage. CFP = color fundus photography; FFA = fundus fluorescein angiography; NPV = negative predictive value; OCT = optical coherence tomography; PPV = positive predictive value; US = United States.

color fundus photography (CFP), the presence of thumb-like pigment epithelial detachment (PED), notched PED, or double layer signs on optical coherence tomography (OCT), or the presence of occult choroidal neovascularization on fundus fluorescein angiography (FFA). When some of these clues are identified on clinical examination, a provisional diagnosis of PCV often can be made, even without ICGA information.

A few studies have reported the high sensitivity and high specificity of OCT in detecting PCV.[10–13] However, when evaluating patients, physicians usually get information from fundus examination along with OCT rather than OCT alone. Physicians sometimes also use FFA, an imaging tool that is more available worldwide than ICGA. Therefore, this study aims to determine sensitivity, specificity, and predictive accuracy (area under the receiver operating characteristic curve [AUC]) of using CFP, OCT, and FFA in diagnosing PCV without ICGA information, and to determine if there is any difference in the results when images are evaluated by graders working inside vs outside a PCV endemic area.

METHODS

THIS WAS A VALIDITY ANALYSIS OF PATIENTS WITH NEWLY diagnosed serous or serosanguinous maculopathy, including PCV, NVAMD, or central serous chorioretinopathy (CSC) in 1 or both eyes seen at Chiang Mai University Hospital between January 1, 2013 to June 30, 2015 (2.5-year period). The study was prospectively approved