

Handstand push up Valsalva retinopathy mimicking Acute macular neuroretinopathy

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Background: The Valsalva retinopathy is frequently a benign transient incident and prior observations with noninvasive imaging have detected blood vary size hemorrhages through different retinal layers spread on fundus pole and also within the particular Henle fiber layer trail (1). There has been only scarce published case reports involving handstand position exercise and Valsalva retinopathy but no one occurring in concomitant, simulating or as a trigger of acute macular neuropathy by multimodal imaging findings on particular deep vascular complex (2).

(1). Bauml CR, Sarraf D, Bryant T, et al. Henle fibre layer haemorrhage: clinical features and pathogenesis. Br J Ophthalmol. 2021 Mar;105(3):374-380. doi: 10.1136/bjophthalmol-2019-315443. Epub 2020 May 6.

(2). Munk MR, Jampol LM, Cunha Souza E, de Andrade GC, Esmaili DD, Sarraf D, Fawzi AA. New associations of classic acute macular neuroretinopathy. Br J Ophthalmol. 2016 Mar;100(3):389-94. doi: 10.1136/bjophthalmol-2015-306845. Epub 2015 Aug 20. PMID: 26294104.

Case presentation: 32-year-old man with unilateral central blurred vision just after handstand push-up exercise. **Methods:** The patient have undergone ophthalmic examination including multimodal evaluation with color fundus retinography, fluorescein angiography (FA), near-infrared reflectance (near-IR) scanning laser ophthalmoscopy, blue autofluorescence and spectral-domain optical coherence tomography (SD-OCT) after one month symptoms onset.

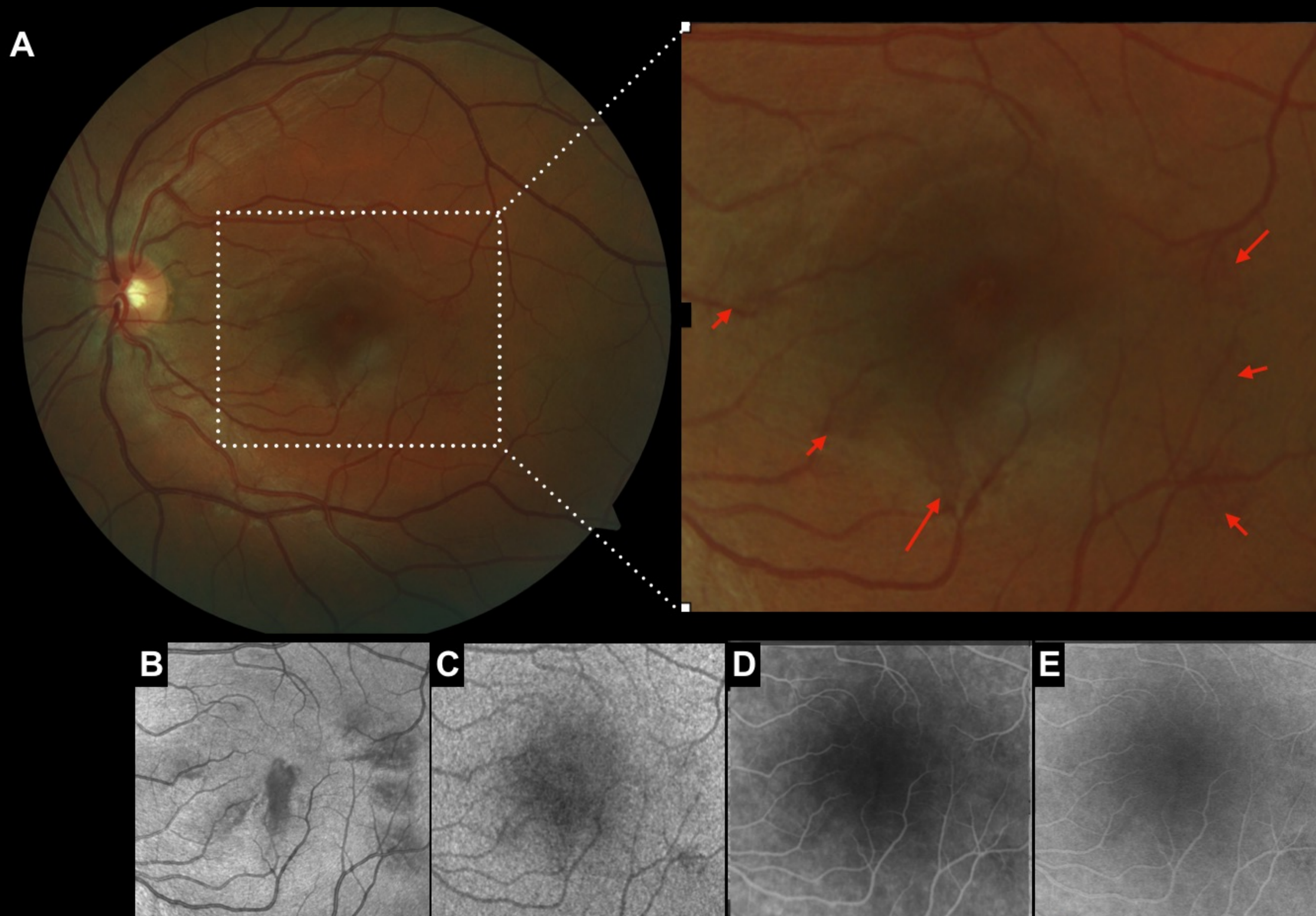


Figure 1. Multimodal imaging Assessment. Baseline imaging 4 weeks forward ocular symptoms onset. (A) Color fundus and zoomed foveal and parafoveal area revealing intraretinal reddish blood-clusters (red arrows) including at foveolar centre (largest red arrow). (B) Hyporeflectance near-infrared patches correlated with intraretinal deep vascular plexus hemorrhages at foveal and parafoveal area. (C) Light hypoautofluorescence correlated with intraretinal deep vascular plexus hemorrhages autofluorescence blockage. (D) Fluorescein angiography early phase demonstrating light hypofluorescence and on late FA phase as well (E) meaning intraretinal deep vascular plexus hemorrhages fluorescein blockage.

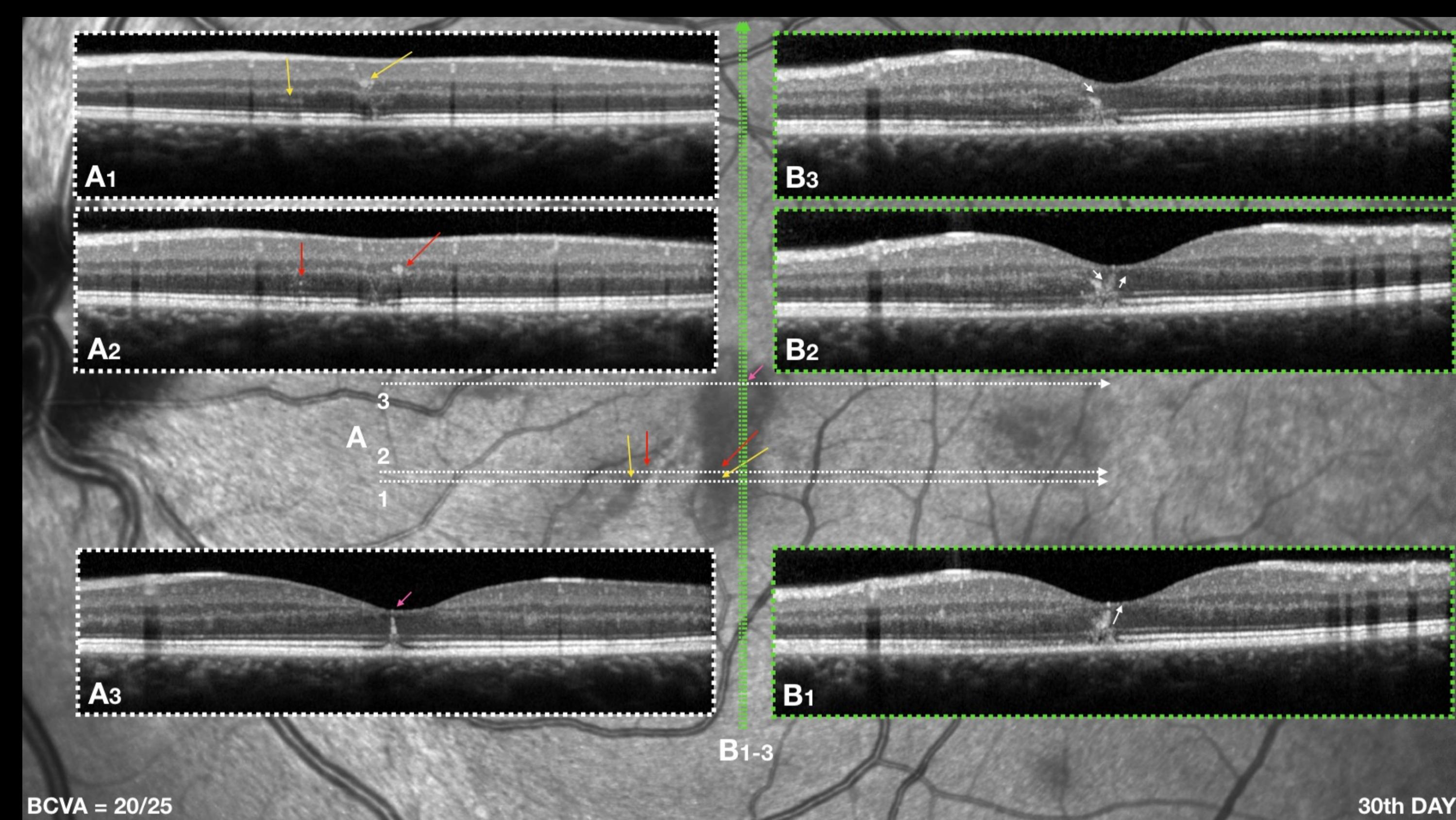


Figure 2. Near-infrared and SD-OCT sections 30 days forward initial symptoms. A1-A2, horizontal SD-OCT section (white dashed line) revealed microhemorrhages clusters (red-yellow diagonal arrows), at INL layer consecutively to deep vascular complex breakdown and nearby temporally areas (red-yellow vertical arrows) may from different time-resolution hemorrhages showing linear hyperreflective sign on SD-OCT at ONL. Under that, there is a hyperreflective down extension drainage through ONL shadowing the EZ and IZ layers and reaching foveola-center area with hyperreflective pyramid sign (pink arrow) on SD-OCT section (A3). B3-B1 centripetal vertical SD-OCT sections showing likely deep downstream blood-flow with SD-OCT hyperreflective signal (B3, white down arrow), forward upstream blood-flow centrally SD-OCT light hyperreflective signal (B2, white up arrow), forward upstream blood-flow centrally SD-OCT hyperreflective signal (B1, white up arrow). Possible “up-side down” patient position hemorrhage effect through radial fibers-Henle direction.

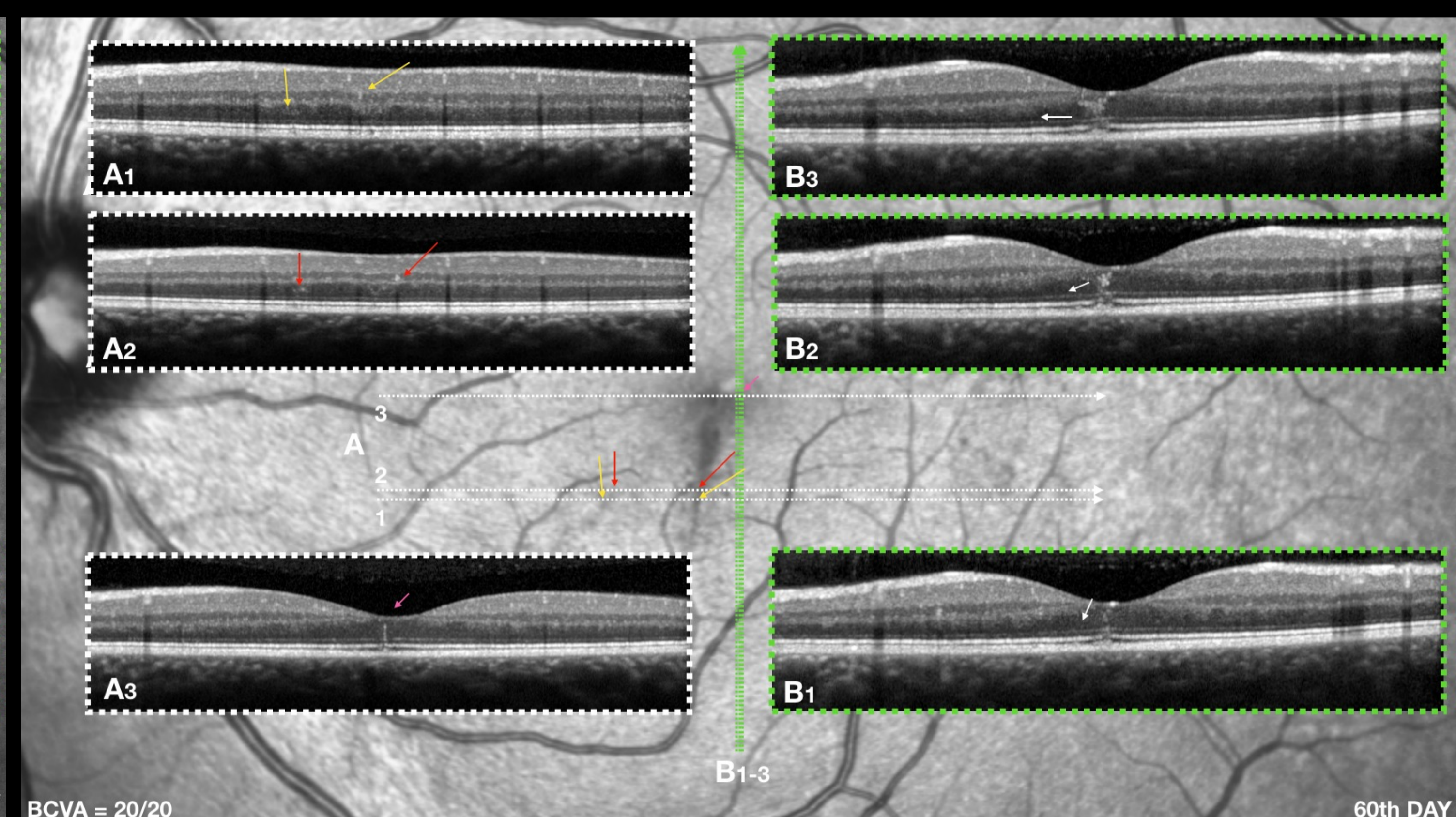


Figure 3. Near-infrared and SD-OCT sections 60 days forward initial symptoms. A1-A2, horizontal SD-OCT section (white dashed line) revealed microhemorrhages clusters resolution (red-yellow diagonal arrows), at INL layer consecutively to past deep vascular complex breakdown and nearby temporally areas (red-yellow vertical arrows) may from different time-resolution hemorrhages showing weak linear hyperreflective sign on SD-OCT at ONL. Under that, there is a faded hyperreflective down extension drainage through ONL without shadowing the EZ and IZ layers and reaching foveola-center area with decreased hyperreflective pyramid sign (pink arrow) on SD-OCT section (A3). B3-B1 centripetal vertical SD-OCT sections showing likely downstream blood-flow in absorption SD-OCT hyperreflective signal (B3, white down arrow), forward up/downstream blood flow in absorption SD-OCT hyperreflective signal (B2, white down arrow), forward faded downstream blood-flow in absorption centrally SD-OCT hyperreflective signal (B1, white down arrow). Possible posterior “stand up” patient position correlated to hemorrhage absorption through radial fibers-Henle direction.

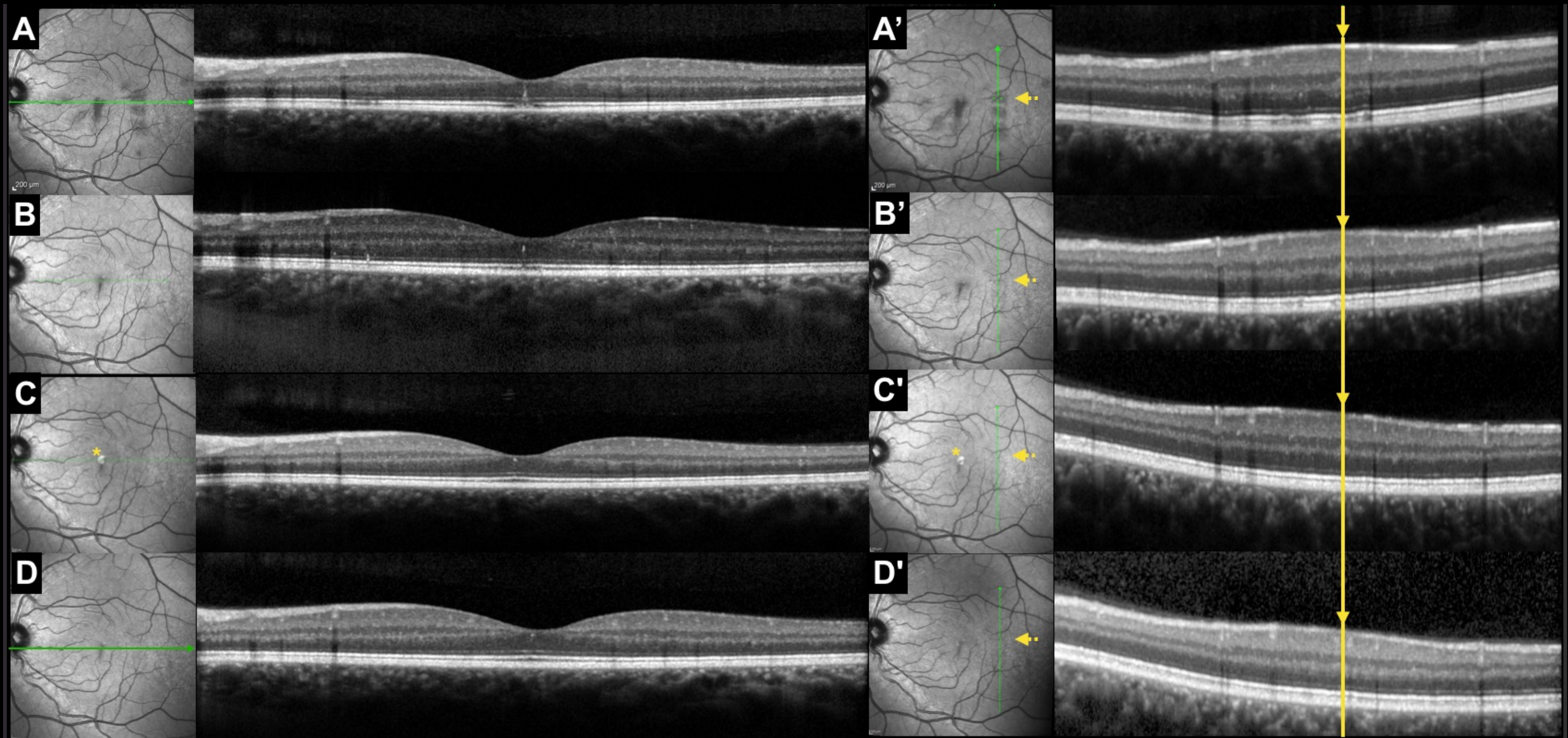


Figure 4. One year follow-up. Baseline imaging 4 weeks forward ocular symptoms onset: (A) Near-infrared hyporeflectance foveolar centre correlated with hyperreflective sign on SD-OCT horizontal sectioning at foveolar centre. (A') Near-infrared hyporeflectance parafoveal patches correlated with hyperreflective linear sign on vertical SD-OCT sectioning just below the OPL within the ONL causing hyporeflective shadowing at EZ and IZ layers. **Eight weeks imaging forward ocular symptoms onset:** (B) Near-infrared tiny hyporeflectance on foveolar centre correlated with tiny hyperreflective sign on SD-OCT horizontal sectioning at foveolar centre. (B') Near-infrared faded hyporeflectance parafoveal patches correlated with barely visible linear sign on vertical SD-OCT sectioning just below the OPL within the ONL causing scant shadowing at EZ and IZ layers. **Nine months imaging forward ocular symptoms onset:** (C) Near-infrared tiny faded hyporeflectance on foveolar centre correlated with tiny-dot hyperreflective sign on SD-OCT horizontal sectioning at foveolar centre. (C') Regular Near-infrared reflectance and vertical regular layers on SD-OCT sectioning imaging. (*) yellow asterisks on foveolar-centre revealing white optical artefact image. **One year imaging forward ocular symptoms onset:** (D) Near-infrared barely visible hyporeflectance on foveolar centre correlated with SD-OCT horizontal sectioning showing tiny-dot faded hyperreflective sign at foveolar centre. (D') Regular Near-infrared reflectance and vertical regular layers on SD-OCT sectioning imaging.

Table 1. PAMM-AMN and/or Valsalva retinal vascular changes spectrum plus other differential diagnosis with outer retinal layer affections

ISCHEMIA AND/OR BRB INSTABILITY WITH RETINAL LAYER (RL) CHANGES								RPE/RL CHANGES NOT BRB RELATED			
PAMM/AMN spectrum	PAMM itself	PAMM + AMN	AMN itself (¶)	AMN-like in "Minor VALSALVA"	AMN-like in "moderate VALSALVA" (Ω)	AMN-like in "Severe VALSALVA"	AMN-like in non-VALSALVA spontaneous hemorrhages	ARPE (¥, #)	FOVEALITIS (π, #)	POPPERS (¥)	UAIM (#, ≠)
Retina vascular plexos and BRBi	ICP (Spasmus/ischaemia)	DVP (ICP+DCP) and/or choriocapillaries (Spasmus/ischaemia)	DCP and/or choriocapillaries (Spasmus/ischaemia)	DVP(ICP+DCP) Intraretinal blood clusters and/or choriocapillaries (*)	HFLH (Intraretinal blood leakage)	SVP(SCP+RPCP), vitreous, pre-retinal(subILM or subHyaloid) and DVP. [Multiple extra- (largely) and intraretinal blood hemorrhages]	SVP + DVP mainly [Multiple extra- and intraretinal (mainly) blood hemorrhages]	∅	∅ (****)	∅ (***)	∅ (****)
Retina layer thinning or sequelae	INL (**)	INL + ONL (**)	ONL (**)	∅	∅	∅	∅	MH sequelae (rarely)	∅	(1) ∅ (2) ∅ (3) MH	∅
ORL OCT irregularities	∅	ELM attenuation/IZ-EZ disruption (associated)	ELM attenuation/IZ-EZ disruption (necessary)	IZ-EZ disruption (associated)	IZ-EZ disruption (associated) and/or blood shadowing	IZ-EZ disruption (associated) and/or blood shadowing	IZ-EZ disruption (associated) and/or blood shadowing	IZ-EZ disruption	IZ-EZ/ELM defect	(1) IZ-EZ attenuation, (2) subfoveal detachment (vitelliform-like), (3) IZ-EZ defect	RPE/IZ-EZ irregularities or bacillary SRD (≠)
OCT hyperreflectivity	INL	INL + OPL (early) / ONL(late)	OPL (early) and ONL (later)	Transitory OPL (early) and ONL (late)	Transitory ONL/Henle layer sign	Transitory any layer sign	Transitory ONL/IZ-EZ sign	Presence or not of transitory ONL sign	Transitory ILM/ONL sign ("plumes")	(1) ELM/IZ-EZ bumping (2) ELM/IZ-EZ sign (3) ∅	Transitory IZ-EZ thickening
NEAR-IR Hyporeflectance	Several shape patches	Several shape patches + wedge-shaped (juxta-parafoveal retina)	Wedge-shaped patches (juxta-parafoveal): tear eyedrops/petaloid sign	Wedge-shaped patches (juxta-parafoveal): "Cougar footprint sign"	Juxtafoveal superficial radial petaloid/ feathery sign	Multiple posterior pole shape size lesions	Multiple posterior pole shape size lesions	Central foveal Hyperreflectance	Central foveal Hyperreflectance	Central foveal regular or Hyporeflectance	Central Mottled Hyporeflectance
Retina fundus	Juxta/parafoveal pale lesions	Juxta/parafoveal pale lesions	Juxtafoveal brown-reddish patches	Juxtafoveal reddish patches	Juxtafoveal superficial radial blood hemorrhages	Multiple shape size hemorrhages	Multiple shape size hemorrhages	Stippling macula surrounded by hypo pigmented halos	Foveolar central yellow-white punctate and surrounded changes	(1) subtle yellowish lesion, (2) yellow spots + subtle pigmentary clumps, (3) subtle yellow dot	Yellowish-white exudates plus little red dots (hemorrhages)

Abbreviation: BRB, blood-retinal barrier. BRBi, blood retinal barrier instability. RL, retinal layer. PAMM, paracentral acute middle maculopathy. AMN, acute macular neuroretinopathy. ARPE, acute retinal pigment epithelitis. SVP, superficial capillary plexus. SCP, superficial capillary plexus, RPCP, radial peripapillary capillary plexus. DVP, deep vascular plexus. DCP, deep capillary plexus. ICP, intermediate capillary plexus. HFLH, Hence fibre layer hemorrhage. INL, inner nuclear layer. ONL, outer nuclear layer. OPL, outer plexiform layer. IZ, interdigitation layer. EZ, ellipsoid layer. IR, infrared. OCT, optical coherence tomography. ORL, outer retinal layer. MH, microhole. UAIM, unilateral acute idiopathic maculopathy.

- (*) Multimodal imaging outcomes from our case report uncertainly prove choriocapillaries vessels compromising as there was no OCTA evaluation.
- (**) Retinal Ischaemia: PAMM (Scharf et al. 2020), PAMM+AMN (Iovino C et al. 2022) and AMN (Fawzi et al. 2012).
- (***) Choriocapillaries ischaemia may related to Poppers maculopathy (Romano F et al. 2019) or not (Hamann T et al. 2021) and may related to UAIM (Fernández-Avellaneda P et al. 2022).
- (****) A concomitance COVID infection in case report (Muñoz-Solano J et al. 2022) showing intraretinal blood-clusters (a possible BRB instability from DVP).

Differential diagnosis and clinical associations:
 (¶) virus affection (flu-like, dengue fever, COVID-19 infection, chikungunya), caffeine excessive uses, women anticonceptive users, COVID-19 vaccine, sickle cell retinopathy, idiopathic intracranial hypertension, Susac syndrome, thrombocytopenia, anaemia, hyperviscosity, hypovolaemia, dehydration, sympathomimetic drugs (lisdexamphetamine), leucocytosis, leucoblastocystis, chronic kidney disease, and ulcerative colitis. (Ω) **Elevated central venous pressure:** Valsalva-manoeuvre, Terson's syndrome, trauma, Whiplash maculopathy, epidural injection, general anaesthesia. **Elevated local retinavenous pressure:** retinal vein occlusion, decompression maculopathy, blunt globe trauma, face-down positioning and expansile gas postvitrectomy, macular telangiectasia type 2. **Choroidal vascular:** PCV, AMN and CNV type 2 from high miopia. (¥) solar maculopathy. (π) laser pointer injuries. (#) multiple evanescent white dot syndrome (MEWDS)/multifocal choroiditis (MFC). (≠) **Bacillary SRD:** Vogt-Koyanagi-Harada, tuberculosis, posterior scleritis, acute placoid macular posterior pigmented epitheliopathy, toxoplasmosis.

Discussion/Conclusion: This is first-time case report of AMN-like forward handstand push-up exercise assembling findings that suggest a particular characteristic mark on near-IR ("cougar footprint") and may predict a benign and early visual symptoms recovery and also hopefulness anatomical retrieval forward one year follow-up without outer retinal layers thinning sequel.