ISSN: 2362-1303 (Paper) | eISSN: 2362-1311 (Online) August 2025
JOURNAL OF ADVANCE ACADEMIC RESEARCH (JAAR)

Choroidal neovascular membrane characteristics in Age-Related Macular Degeneration: Insights from Angiography and Optical Coherence Tomography

Kiran Shakya[1] ,Sudha Ranabhat[1], Arun Prasad Dhungana[1], Sangita Shakya[2]
[1]Nepal Eye Hospital, Tripureshwor, Kathmandu, [2]NACOL, Kathmandu
Corresponding Author: Kiran Shakya | Email: kiranshakya2025@gmail.com
Received 2 August 2025 | Accepted 16 August 2025 | Published 30 August 2025

Abstract

Background:Choroidal neovascular membrane (CNVM) is common problems and causes loss of central sight in the geriatric population. This is essential to comprehend the morphological characteristics of CNVM and baseline visual acuity (VA) in age-related macular degeneration (AMD).

Objective

To examine the correlation between new patients with untreated AMD and their baseline VA, demographic, angiographic, and spectral-domain OCT (SD-OCT) CNVM features.

Methods

A study was conducted at a tertiary eye hospital on 50 eyes belonging to consecutive individuals with newly diagnosed and untreated AMD from June 2022 to May 2023. Snellen baseline visual acuity (VA) was converted to the LogMAR scale. SD-OCT biomarkers were meticulously study for intraretinal fluid (IRF), subretinal fluid (SRF), sub-RPE fluid (SRPE), hyperreflective material (HRM), photoreceptor disruption, hyperreflective foci (HRF), and Outer retinal tubulation (ORT). OCT angiography helped to find choroidal neovascular membrane type and location.

Results

In this study, 28 (56%) of the participants in this study were male, and the mean age was 73.3 ± 8.7 years.The baseline visual acuity VA) score in this study was 1.06±0.38 Log MAR. Visual acuity was observed to be considerably lower when SRF (p=0.01) and SRPE (p=0.03) were present.Age, sex, CNVM types, lesion pattern, and the presence of IRF, HRM, photoreceptor disruption, ORT, or HRF did not significantly correlate with BCVA.

Conclusion

In the untreated AMD, the presence of SRF and SRPE fluid on SD-OCT were significant biomarkers for worse baseline visual function. In contrast, CNVM type and other OCT biomarkers showed no significant association with initial visual acuity.
Keywords: AMD, Neovascularization, OCT, Visual Acuity, Biomarkers.

Introduction

Choroidal neovascular membrane (CNVM) causes loss of central vision in the elderly population. Neovascular age-related macular degeneration, or nAMD, is one of the primary

causes of severe and irreversible loss of sight in the elderly population worldwide (Jonas et al., 2017).

The prevalence of wet AMD increases significantly 37.6% of all AMD cases in a hospital-based study (Thapa et al., 2012). Anti-vascular endothelial growth factor (anti-VEGF) stabilizes and frequently improve vision is common form of treatment.

The diagnosis and management of AMD are heavily reliant on imaging, specifically high-resolution cross-sectional pictures of the retina using spectral-domain optical coherence tomography (SD-OCT) (Schmit-Erfurth et in 2014).

SD-OCT elicits identification of specific morphological biomarkers associated with nAMD activity, including intraretinal fluid (IRF), subretinal fluid (SRF), sub-retinal pigment epithelium (sub-RPE) fluid, hyperreflective material (HRM), and hyperreflective foci (HRF)(Waldstein 2016). The CNVM type was divided into Type 1 (sub-RPE), Type 2 (subretinal), and Type 3 (intraretinal) that provided a valuable framework for understanding the disease (Freund et al., 2020).

While these features guide treatment decisions, the precise relationship between these individual morphological parameters and visual status at the time of diagnosis remains an area of active investigation. Some studies suggest that the location and type of fluid may impact visual function differently (Jaffe et al., 2016) (Willoughby et al., 2017).

This study focus on the relationship between baseline visual acuity and SD-OCT biomarkers in patients with newly diagnosed, untreated AMD is the main focus of this investigation.

Methodology

Study Design

A hospital based descriptive study was performed in 50 eyes diagnosed with untreated nAMD at a tertiary eye hospital from June 2022 to May 2023. Inclusion criteria were: (1) a new diagnosis of active nAMD confirmed by clinical examination and SD-OCT, and OCT angiography; and Exclusion criteria included: (1) any previous treated nAMD; (2) presence of other sight-threatening retinal diseases like diabetic retinopathy, retinal vein occlusion); (3) significant media opacities precluding quality imaging; and (4) presence of macular fibrosis or atrophy involving the fovea at baseline. The ethical approved was taken from the Institutional Review Board.

Data Collection with Image Analysis

The affected eye and demographic information (age, sex) were noted. LogMAR was utilized for statistical analysis once Snellen VA was changed to it. Comprehensive SD-OCT and OCTA imaging were performed on each subject (Spectralis OCT, Heidelberg Engineering).

CNVM Type

Classified as Type I, II, or III.

Lesion Pattern: Categorized as Medusa, Sea Fan, Prudent, or Ill-Defined.

Fluid Compartments: Presence of IRF, SRF, and SRPE.

Other OCT Biomarkers: Presence of HRM, photoreceptor disruption, hyperreflective foci (HRF),

and Outer retinal tubulation (ORT).

SPSS version 21 was used for data analysis. ANOVA, chi-square tests, and Pearson correlation were used for additional analysis.

A p-value below 0.05 was regarded as statistically significant.

Results

Baseline study

The study found that the mean age was 73.3 ± 8.7 years, and 28 (56%) were male. The mean LogMAR VA was 1.06 ± 0.38. The left eye was affected in 29 (58%) cases. Regarding type of CNVM, 29 (58%) Type I, 17 (34%) Type II, and 1 (2%) Type III; 3 (6%) ungradable were found. The most common lesion patterns were Medusa and Sea Fan (18 eyes each, 36%). The OCT biomarkers were summarized in Table 1. IRF was nearly ubiquitous (98%), while SRF and SRPE were present in 44% and 34% of eyes, respectively.

Biomarker	Present (n, %)
Intraretinal Fluid (IRF)	49 (98%)
Subretinal Fluid (SRF)	22 (44%)
Sub-RPE Fluid (SRPE)	17 (34%)
Hyperrefective Material (HRM)	38 (76%)
Photoreceptor Disruption	37 (74%)
Hyperreflective Foci (HRF)	42 (84%)
Outer retinal tubulation (ORT)	12 (24%)
Others (various)	6

Association of Visual Acuity with Demographics and CNVM Type

Age and baseline VA LogMAR did not correlate statistically significantly (r = +0.19, p = 0.19). Males and females (1.06 vs. 1.06, p = 0.97), left and right eyes (1.08 vs. 1.03, p = 0.61), and CNVM Type I and Type II (1.07 vs. 1.06, p = 0.92) did not significantly differ in mean baseline VA. (Table 2)

Association of Visual Acuity with OCT Biomarkers

The SRF was associated with significantly worse baseline VA compared to eyes without SRF (mean LogMAR 1.18 vs. 0.97, p = 0.01). Similarly, SRPE fluid was also associated with worse VA (1.20 vs. 0.99, p = 0.03). The presence of IRF, HRM, Photoreceptor disruption, ORT, or HRF showed no significant association with baseline VA (Table 2).

Table 2: Association between Preoperative LogMAR Visual Acuity and Study Variables

Variable	Category	n	Mean (SD)	LogMAR
Sex	Male	28	1.06 (0.38)	0.97
	Female	22	1.06 (0.38)	
CNVM Type	Type I	29	1.07 (0.38)	0.92
	Type II	17	1.06 (0.39)	
SRF	Present	22	1.18 (0.38)	0.01
	Absent	28	0.97 (0.35)	
SRPE	Present	17	1.20 (0.40)	0.03
	Absent	33	0.99 (0.35)	
HRM	Present	38	1.03 (0.37)	0.13
	Absent	12	1.16 (0.40)	
HRF	Present	42	1.08 (0.38)	0.32
	Absent	8	0.96 (0.37)	

Figure 1: OCT Left Eye

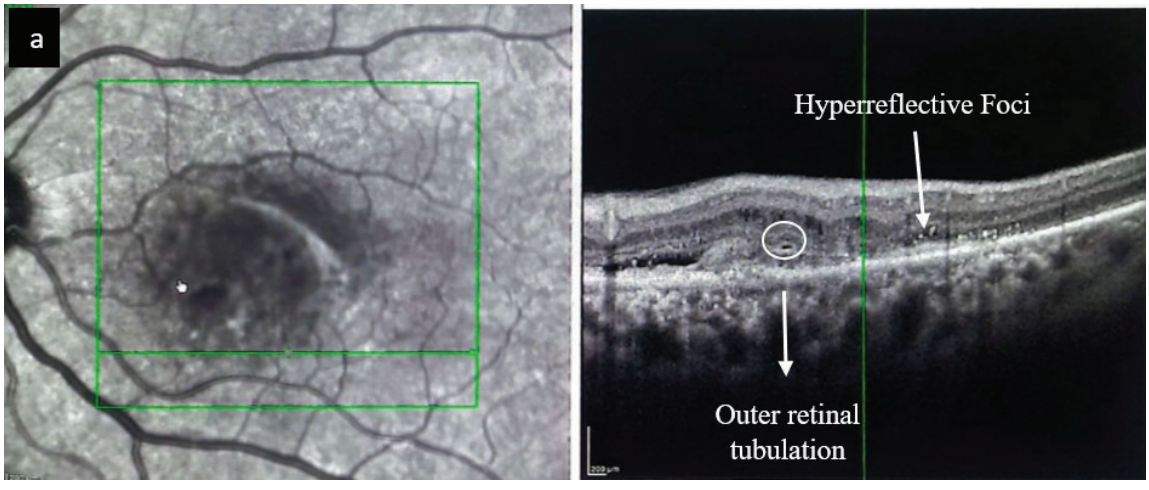


Figure 2: OCT Right Eye

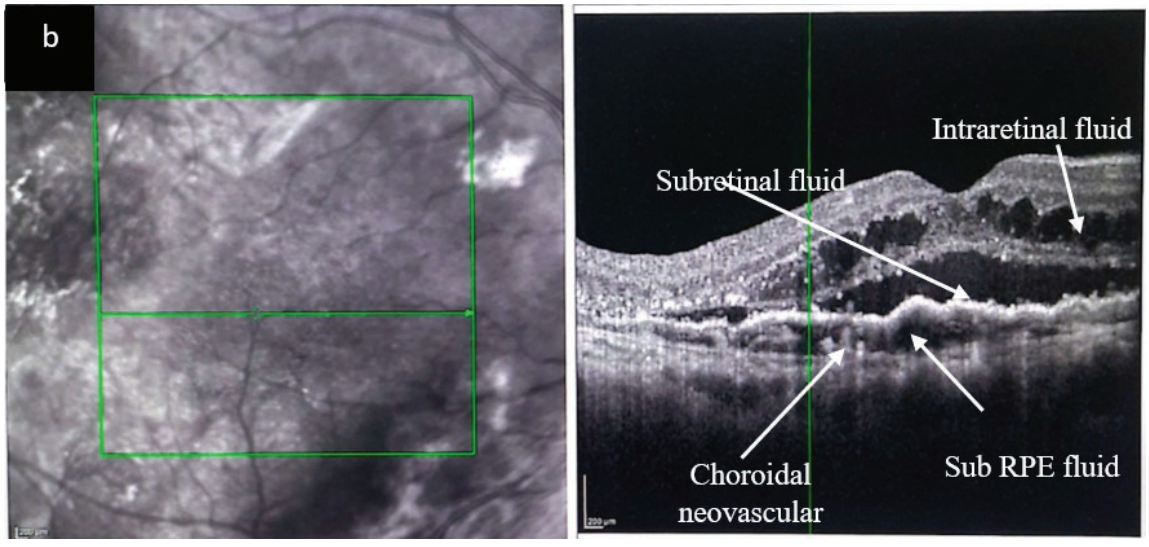
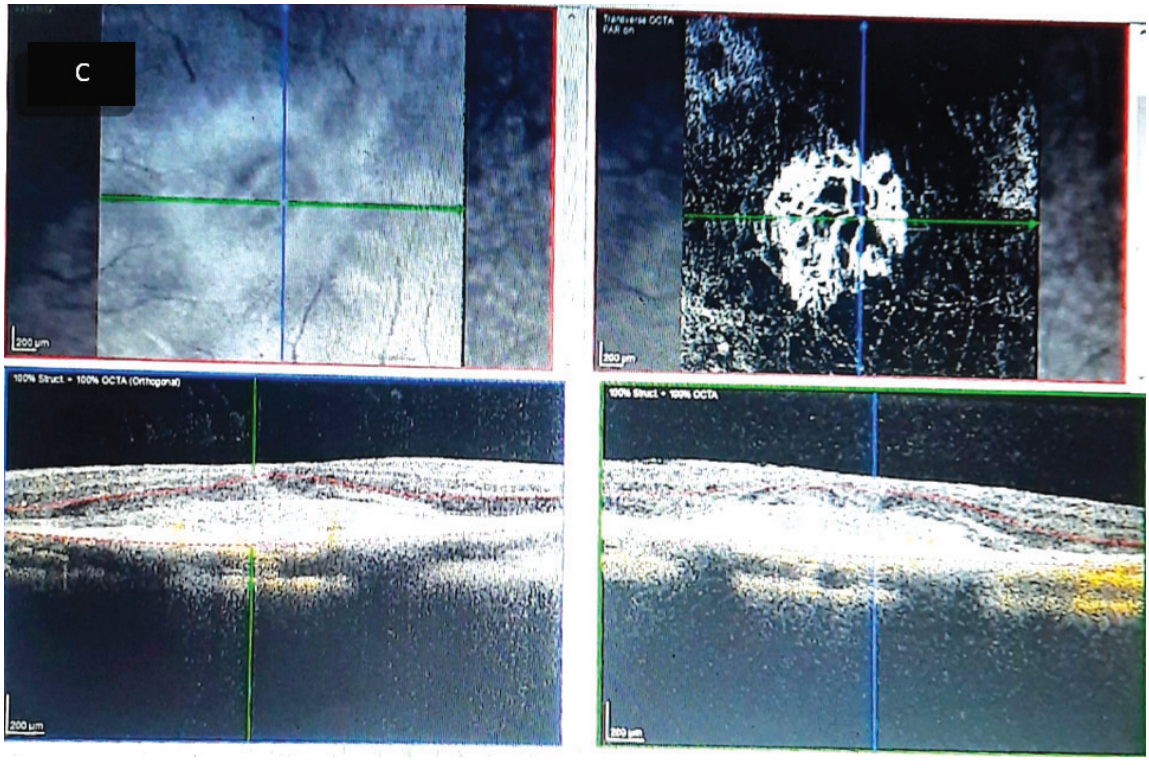


Figure 3: Medusa head enface OCTA



Discussion

This prospective 50 untreated nAMD patient eye study identified the subretinal fluid (SRF) and sub-RPE fluid (SRPE) as the most significant morphological predictors of worse visual acuity. The finding that SRF is associated with poorer vision is in agreement with established pathophysiology. The CATT study group determined that higher baseline foveal retinal thickness and subfoveal tissue complex thickness (including SRF and fibrovascular tissue) were associated with worse baseline VA.(Jaffe et al., 2016) (Xu et al., 2017). The results validate SRF as an important biomarker of acute vision impairment.

Likewise, there is a clinically significant correlation between SRPE and worse VA. SRPE, which is frequently a pigment epithelial detachment (PED), can result in visual loss via a number of processes, including as direct obscuration of the fovea, subsequent malfunction of the photoreceptors, and deformation of the overlaying retina (Nagiel et al., 2015).

Intra retinal Fluid (IRF) as a distinguishing factor for VA was constrained by its nearly universal occurrence (98%) in our population. Depending on its position and amount, IRF may have a more varied and maybe less severe effect on vision than fluid in the subretinal region, despite being a clear indication of active disease (Willoughby et al., 2017).

Interestingly, we found no significant difference in VA between CNVM types. This suggests that while the anatomical location of the neovascular complex differs, the resulting sequelae—namely, the fluid in the subretinal and sub-RPE spaces are primary determinants of visual loss, not the classification itself. This finding underscores the importance of treating the observable fluid and exudation rather than the underlying type.

Limitations

Small sample size was considered as the limitation of this study. The qualitative, binary grading of OCT features (present/absent) does not account for the quantitative volume or extent of fluid, which may have a stronger correlation with VA.

Conclusion

In conclusion, the most important biomarkers for baseline VA in untreated AMD on SD-OCT are the sub-retinal fluid and sub-RPE fluid. The vital factor influencing visual function upon diagnosis is the precise position of fluid, not the type of CNVM or other morphological characteristics.

Reference

*Jonas, J. B., Cheung, C. M. G., & Panda-Jonas, S. (2017). Updates on the epidemiology of age-related macular degeneration. *Asia-Pacific Journal of Ophthalmology, 6*(6), 493–497. https://doi.org/10.22608/APO.2017251*

Thapa, S. S., Thapa, R., Paudyal, I., Khanal, S., Aujla, J., Paudyal, G., & et al. (2012). Pattern of age-related macular degeneration in Nepal: A hospital based study. Nepal Journal of Ophthalmology, 4(8), 205–209. https://doi.org/10.3126/nepjoph.v4i2.6545

Schmidt-Erfurth, U., Chong, V., Loewenstein, A., Larsen, M., Souied, E., Schlingemann, R., & et al. (2014).

Guidelines for the management of neovascular age-related macular degeneration by the European Society of Retina Specialists (EURETINA). Progress in Retinal and Eye Research, 41, 48–67. https://doi.org/10.1016/j.preteyeres.2014.02.002

Coscas, G., Soubrane, G., Bandello, F., Souied, E. H., Hartnett, M. E., Spaide, R. F., & et al. (2014). Optical coherence tomography in age-related macular degeneration. Ophthalmologica, 232(2), 65–116. https://doi.org/10.1159/000360367

Waldstein, S. M., Simader, C., Staurenghi, G., Bogunović, I., Sadeghipour, A., Rotsos, T., & et al. (2016). Correlation of 3-dimensionally quantified intraretinal and subretinal fluid with visual acuity in neovascular age-related macular degeneration. American Journal of Ophthalmology, 165, 78–85. https://doi.org/10.1016/j.ajo.2016.02.022

Freund, K. B., Sarraf, D., Spaide, R. F., Staurenghi, G., & Yannuzzi, L. A. (2020). The 2019 Krill Lecture: Rethinking the 'Type 3 Neovascularization' and 'Polypoidal Choroidal Vasculopathy' complex. American Journal of Ophthalmology, 218, 1–11. https://doi.org/10.1016/j.ajo.2020.05.002

Jaffe, G. J., Ying, G., Toth, C. A., Daniel, E., & Grunwald, J. E. (2016). Macular morphology and visual acuity in the second year of the Comparison of Age-Related Macular Degeneration Treatments Trials (CATT). Ophthalmology, 123(4), 865–875. https://doi.org/10.1016/j.ophtha.2015.12.002

Willoughby, A. S., Ying, G., Toth, C. A., Maguire, M. G., Burns, R. E., Grunwald, J. E., & et al. (2017). Subretinal hyperreflective material in the Comparison of Age-Related Macular Degeneration Treatments Trials. Retina, 37(9), 1621–1631. https://doi.org/10.1097/IAE.0000000000001493

Xu, L., Mrejen, S., Jung, J. J., Thompson, D., Marsiglia, M., Zumbansen, D., & et al. (2017). Pathological implication of retinal layers in neovascular age-related macular degeneration: A spectral domain optical coherence tomography study. Investigative Ophthalmology & Visual Science, 58(8), 3399–3408. https://doi.org/10.1167/iovs.17-21848

Nagiel, A., Freund, K. B., Spaide, R. F., Munch, I. C., Larsen, M., & Sarraf, D. (2015). Type 1 neovascularization: Evolution, association with pigment epithelial detachment, and treatment response as revealed by spectral domain optical coherence tomography. Retina, 35(10), 1915–1935. https://doi.org/10.1097/IAE.0000000000000766