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Current classification of macular neovascularization in the course of AMD based on the Consensus Nomenclature for Reporting Neovascular Age-Related Macular Degeneration Data

Anna Piotrowicz, Katarzyna Paczwa, Joanna Gołębiewska, Radosław Różycki

Department of Ophthalmology, Military Institute of Aviation Medicine, Warsaw
Head of Department: Radosław Różycki, MD, PhD

HIGHLIGHTS

The classification of subretinal neovascularization in the course of AMD has changed due to the advancement of diagnostic and therapeutic techniques. The new classification of macular neovascularization refers to each neovascularization in macula, regardless of the cause.

ABSTRACT

Despite the improvement of diagnostic and therapeutic techniques age-related macular degeneration is still one of the main causes of central vision impairment.

Throughout the years, the classification of subretinal neovascularization in the course of age-related macular degeneration has changed due to the advancement of diagnostic and therapeutic techniques. In 2020 an expert panel reached consensus on a new nomenclature for neovascularization in the course of age-related macular degeneration introducing the concept of macular neovascularization, which refers to each neovascularization in macula, regardless of the location.

Key words: classification of macular neovascularization, age-related macular degeneration, neovascular membrane, angio-OCT

INTRODUCTION

Age-related macular degeneration (AMD) is one of the main causes of central vision impairment in people aged 55 and older. In its course, there is a damage to the structure and function of the macula. According to the classification of the Age-Related Eye Disease Study Group (AREDS), AMD is differentiated into dry and exudative forms, based on the presence of choroidal neovascularization (CNV) [1]. Throughout the years, the classification of subretinal neovascularization in the course of AMD has changed due to the advancement of diagnostic and therapeutic techniques. Previous classifications were based primarily on color fundus images and fluorescein angiography (AF) images, which to date is considered the gold standard for diagnostics, localization, and monitoring of neovascular membrane activity. Although, AF does not address many new aspects obtained through modern imaging methods, such as optical coherence tomography (OCT) or OCT--angiography (OCTA) [2].

PREVIOUS CLASSIFICATION OF NEOVASCULARIZATION

The current classification distinguishes the following types of neovascularization:

- occult choroidal neovascularization (type 1 CNV)
- classic choroidal neovascularization (type 2 CNV)
- minimally classic choroidal neovascularization (mixed CNV)
- retinal angiomatous proliferation (RAP, type 3 neovascularization)
- polypoidal choroidal vasculopathy (PCV).

Recently, nonexudative CNV has been further distinguished, which is not accompanied by subretinal or intraretinal fluid. It may only be diagnosed in angio-OCT [3].
After treatment with anti-VEGF injections, neovascular membrane may take the form of a "leafless tree" with evident persistent large central vessels, no dense small vessels at the circumference of the lesion.
The above classification was not accurate enough, as in the course of AMD the process of neovascularization does not always begin in the choroid, as it was indicated by the current nomenclature (CNV, choroidal neovascularization), but also in the deep retinal choroid plexus (RAP, type 3 neovascularization).

CONSENSUS

In 2020, an expert panel reached consensus on a new nomenclature for neovascularization in the course of AMD (Consensus Nomenclature for Reporting Neovascular Age-Related Macular Degeneration Data), introducing the concept of macular neovascularization (MNV), which refers to each neovascularization in macula, regardless of the location [2].
Macular neovascularization indicates the presence of abnormal blood vessels and associated cellular and tissue elements in the outer retinal layers, subretinal space and space under the retinal pigment epithelium (RPE), as well as in the inner retinal layers (RAP), in various combinations. Macular neovascularization in the course of AMD is assessed and classified based on the location of abnormal vessels (tab. 1).

TABLE 1

Types of macular neovascularization.

Current name	Definition	Previous name
Type 1 macular neovascularization (type 1 MNV)	The proliferation of abnormal vessels from the choriocapillaris of the choroid under the retinal pigmented epithelium. It leads to the detachment of the retinal pigmented epithelium.	Occult neovascular membrane (type 1 CNV)
Polypoidal choroidal vasculopathy	MNV variant of type 1. Indocyanine angiography shows characteristic vessel branching and aneurysm-like dilatation.	Polypoidal choroidal vasculopathy
Type 2 macular neovascularization (type 2 MNV)	Neovascularization originating from choroid vessels, crosses Bruch's membrane and the RPE and develops in the subretinal space.	Classic neovascular membrane (type 2 CNV)
Type 1 and 2 mixed macular neovascularization	Neovascularization both under RPE and in the subretinal space.	Mixed neovascular membrane (minimally classic CNV)
Type 3 macular neovascularization (type 3 MNV)	Abnormal vessels originating from the deep retinal plexus that grow toward the outer retinal layers.	Retinal angiomatous proliferation (RAP)

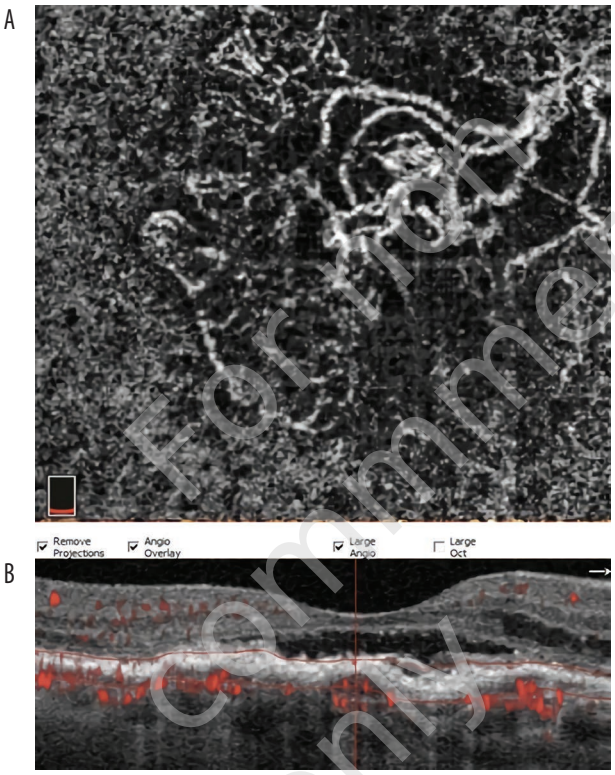
TYPE 1 MACULAR NEOVASCULARIZATION

Type 1 macular neovascularization (type 1 MNV, formerly occult CNV) is the most common type of exudative AMD (circa 40%) and is characterized by pathologic angiogenesis from choroidal choriocapillaris. Vessels proliferate between Bruch's membrane and the retinal pigmented epithelium. Due to its location under the RPE, imaging of the vascular complex is difficult with conventional angiography. Angio-OCT describes the vascular abnormalities in

type 1 MNV as a medusa pattern (vessels proliferate from the center of the lesion outward in all directions), a sea-fan pattern (where more than 90% of the vessels proliferate radially on one side only), or a coral pattern (fig. 1) [4].

FIGURE 1

Angio-OCT picture shows abnormal flow in the area of neovascularization that is located in choriocapillaris (type 1 MNV). Scan B shows increment of thickness of retina, subretinal and intraretinal fluid and irregular retinal pigmented epithelium detachment.

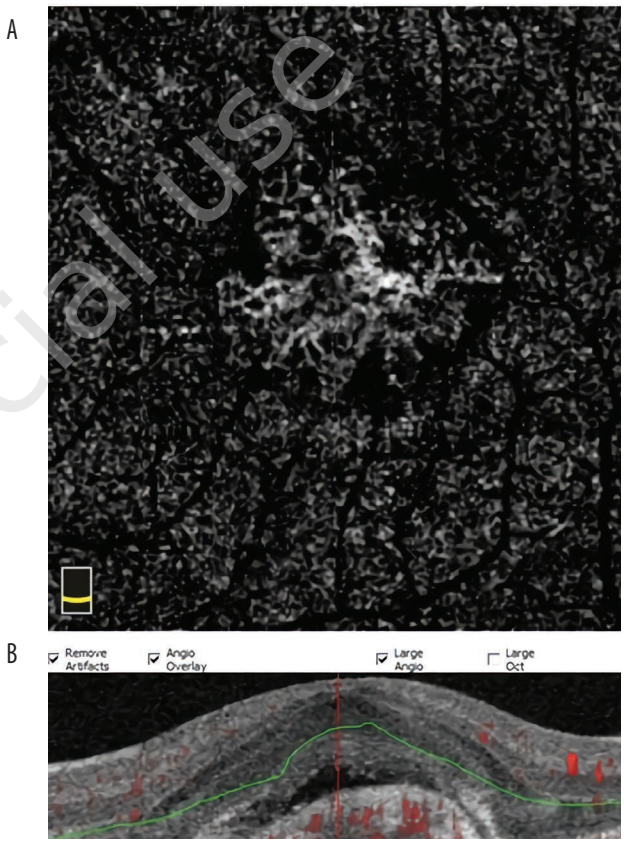


TYPE 2 MACULAR NEOVASCULARIZATION

Type 2 macular neovascularization (type 2 MNV, formerly classic CNV) is the rarest form of exudative AMD and it constitutes circa 9–17% of macular neovascularization cases. It is characterized by the presence of abnormal vessels originating from choroidal choriocapillaris that cross Bruch's membrane and the RPE and develop in the subretinal space. On the basis of angio-OCT (fig. 2), El Ameen et al. described this pattern of neovascular membrane as a medusae-like shape and the complex in the shape of renal glomerulus. Medusa-shaped lesions were defined as a compact zone of new, small blood vessels with minimal hyporeflective structures. Compared to renal glomerulus, lesions are spherical structures of braided vessels separated by hyporeflective spaces [5–7].

FIGURE 2

Angio-OCT picture shows abnormal flow in the area of neovascularization that originated from choriocapillaris through Bruch's membrane and RPE and proliferate in subretinal space (type 2 MNV). Scan B shows significant increment of thickness of retina, flattening of fovea, subretinal fluid and subretinal hyperreflective material.

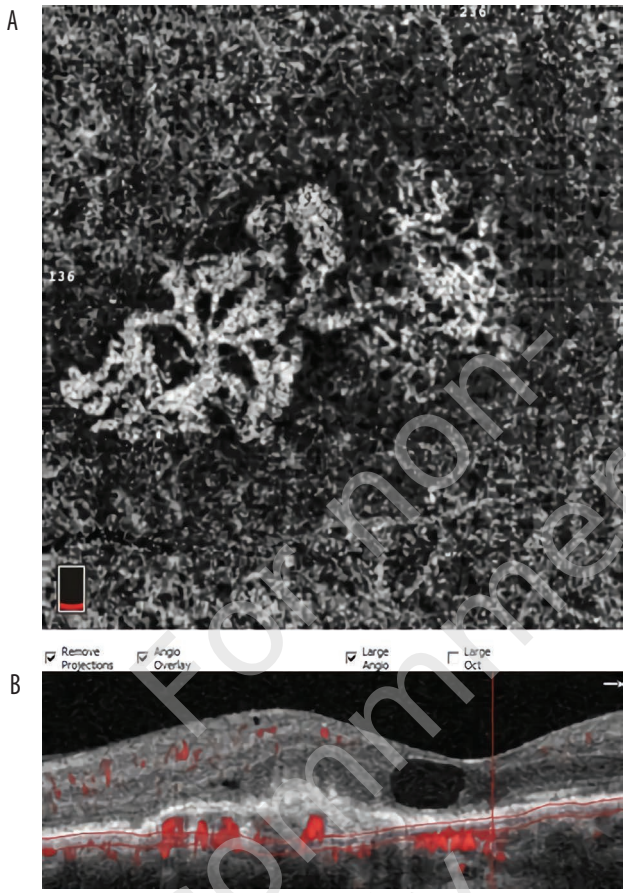


TYPE 1 AND 2 MIXED MACULAR NEOVASCULARIZATION

The mixed type (1 and 2 MNV, formerly minimally classic CNV) is determined by the signs present both in 1 and 2 MNV. In angio-OCT, neovascularization is manifested in the space under the pigmented epithelium and in the subretinal space (fig. 3).

FIGURE 3

Angio-OCT picture shows neovascularization under RPE and in subretinal space (mixed MNV). Scan B shows the increment of thickness of retina, flattening of fovea, intraretinal fluid and irregular retinal pigmented epithelium detachment.



TYPE 3 MACULAR NEOVASCULARIZATION

Type 3 macular neovascularization (type 3 MNV, formerly RAP) is characterized by the presence of new vessels in the deep retinal choroid plexus that grow toward the outer retinal layers (fig. 4) [8].

Angio-OCT describes it as a retinal-retinal anastomosis appearing in the deep capillary plexus, proliferating as a tuft-shaped neovascular lesion with the signs of high flow to the outer retinal layers [9, 10].

POLYPOIDAL CHOROIDAL VASCULOPATHY

PCV is characterized by multiple branching and aneurysmal end-dilated choroidal vessels. Its incidence varies among all races, it is most prevalent in Asian individuals. It was first described by Yannuzzi et al., in 1982, as a chorio-capilar abnormality in the disc area accompanied by serous and hemorrhagic detachment of RPE [11–13]. Indocyanine angiography is the primary examination for the diagnostics of this type of macular neovascularization. It shows a network of branching blood vessels and aneurisma on the outer edge of the branching lesion.

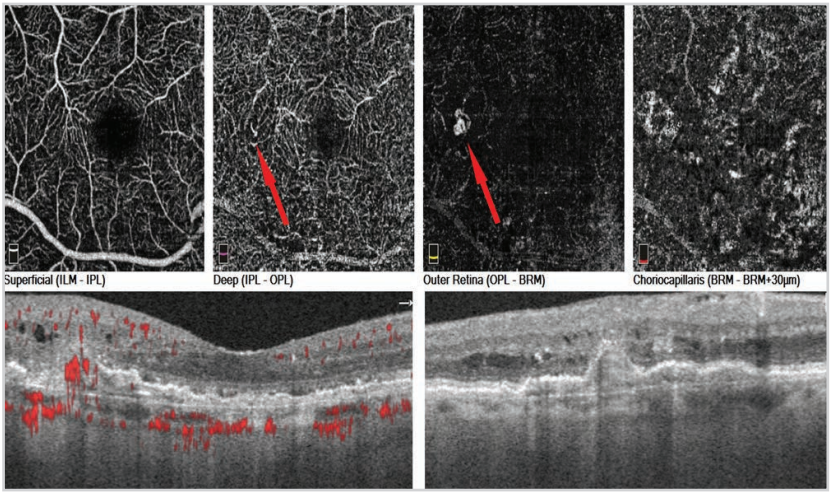
CONCLUSION

The recent advances in imaging diagnostics and reports from clinical trials have significantly changed the understanding of neovascular AMD as a disease entity. Due to constant improvement of diagnostic capabilities, it is possible to precisely differentiate individual forms of the disease and select appropriate treatment.

Figures: from the author's own materials.

FIGURE 4

Angio-OCT pictures show abnormal vessels in the deep retinal choroid plexus that grow toward the outer retinal layers, lesions marked by arrows (type 3 MNV).



CORRESPONDENCE
Anna Piotrowicz, MD
Department of Ophthalmology,
Military Institute of Aviation Medicine
01-755 Warsaw, Krasińskiego 52/54
e-mail: a.piotrowicz91@gmail.com

ORCID
Anna Piotrowicz – ID – https://orcid.org/0000-0003-3910-6251
Katarzyna Paczwa – ID – https://orcid.org/0000-0003-3825-3727
Joanna Gołębiewska – ID – http://orcid.org/0000-0002-3013-4363
Radosław Różycki – ID – http://orcid.org/0000-0001-7040-026X

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The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.