Case Report

Near-Infrared Reflectance Imaging to Detect an Incipient Retinal Arterial Macroaneurysm

Anastasia Zienkiewicz Anibal Francone Maria Paz Cirillo
Tamara Zompa Martin Charles

Retina Division, Centro Oftalmológico Dr. Charles, Ciudad Autónoma de Buenos Aires,
Argentina

Keywords

Retina macroaneurysm · Near-infrared imaging · Optical coherence tomography · High blood pressure · Case report

Abstract

Retinal arterial macroaneurysms (RAM) are characterized by a saccular or fusiform dilation of the retinal artery wall. An 84-year-old Caucasian woman with a medical history of poorly controlled hypertension was diagnosed with RAM in the left eye. Previous macular spectral-domain optical coherence tomography images from the patient were available for comparison. Near-infrared reflectance imaging (NIR-R), taken 3 years before, demonstrated a cuff-type thickening of the arteriolar vessel wall at the site of the current complicated RAM that had gone completely unnoticed. These findings suggest that NIR-R may contribute to the detection of early damage of the arterial wall that may predict arterial aneurysm formation in hypertensive patients.

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Introduction

Retinal arterial macroaneurysm (RAM) is an acquired dilatation of a retinal artery and is strongly associated with systemic hypertension in older women [1, 2]. A significant proportion of asymptomatic RAM patients are never diagnosed; despite its favorable prognosis, multi-level retinal hemorrhages caused by a ruptured RAM can result in serious visual loss, especially when the macula is involved [3]. Early detection, although difficult to accomplish, provides the opportunity to control blood pressure and disclose warning signs of possible retinal complications.

Correspondence to:
Anibal Francone, anibalfrancone@live.com.ar

Near-infrared reflectance imaging (NIR-R) is a noninvasive method of retinal imaging that has the potential to reveal details of most fundus features [4, 5]. However, its role in the detection of macular disease is often not integrated in daily clinical practice. The purpose of this case report is to describe the uncommon early detection of RAM using NIR-R.

Case Report

An 84-year-old Caucasian woman with a medical history of poorly controlled hypertension presented with acute persistent visual loss in the left eye (OS) for 48 h. Her mean cuff pressure from home blood pressure monitoring was 180/100 mm Hg. Best-corrected visual acuity was 20/20 (OD) and count fingers (OS).

Fundus examination of the OD showed signs of hypertensive retinopathy, including arteriolar constriction and arteriovenous nicking, whereas OS examination revealed a dome-shaped subhyaloidal premacular hemorrhage and a clear focal lesion corresponding to a RAM along the inferior temporal retinal arteriole (shown in Fig. 1a), which was associated with bleeding at the subretinal, intraretinal, and preretinal levels. Spectral-domain optical coherence tomography (SD-OCT) was performed using the Spectralis OCT™ with eye-tracking dual-beam technology (Heidelberg Engineering GmbH, Heidelberg, Germany) and reviewed with the Heidelberg Eye Explorer (version 1.8.6.0) using the HRA/Spectralis Viewing Module (version 5.8.3.0). Figure 1b shows that the SD-OCT demarcated the extent of preretinal and intraretinal bleeding. In addition, the NIR-R modality allowed for the visualization of the hemorrhagic RAM within the inferior temporal artery as well as the associated multilayer bleeding.

Previous macular SD-OCT images from the patient were available for comparison. NIR-R taken 3 years prior demonstrated a cuff-type thickening of the arteriolar vessel wall at the site of the current complicated RAM (shown in Fig. 2) that had gone completely unnoticed.

Discussion/Conclusion

Histopathologic study revealed thickening of the vessel walls at the RAM site, with hyaline, fibrin, and foamy macrophages [6]. Progressive aneurysmal changes ranged from the simplest wall thickening type to hemorrhagic aneurysms with a linear split in the vessel wall [7]. These pathological findings illuminated the well-recognized clinical course, including exudation, edema, or hemorrhage in the macula or vitreous cavity, resulting in acute vision loss [8].

Fig. 1. Hemorrhagic RAM. **a** On the near-infrared reflectance image, the white arrow points to the hemorrhagic RAM along the first-order inferior temporal arteriole, and the black asterisk demonstrates preretinal hemorrhage. **b** SD-OCT at the level of the macroaneurysm shows a multilayered hemorrhage involving the sub-inner limiting membrane space (black asterisk) and the intraretinal space (black star). The reliability of the intraretinal layers is significantly affected by the presence of posterior shadowing (white asterisk). RAM, retinal arterial macroaneurysm; SD-OCT, spectral-domain optical coherence tomography.

Fig. 2. **a** On NIR-R of the fundus taken 3 years before, the white arrowhead highlights a cuff-type thickening of the arteriolar vessel wall at the site of the current complicated retinal arterial macroaneurysm. **b** SD-OCT scan shows normal foveal depression and retinal thickness. NIR-R, near-infrared reflectance imaging; SD-OCT, spectral-domain optical coherence tomography.

Many previous studies have underlined how the adoption of a multimodal imaging approach can be helpful to detect, diagnose, and follow-up RAM, even in patients who may be asymptomatic [9, 10]. Despite these advances in imaging, RAMs represent an uncommon retinal finding, especially the cuff early type.

Because of its high sensitivity, NIR-R could be an interesting noninvasive method of *in vivo* evaluation of well-defined retinal vascular abnormalities. In 1990, Eisner et al. [11] reported that the contrasts for retinal veins and arteries obtained with NIR-R scanning laser ophthalmoscope were similar to those obtained with a shorter wavelength light. In our study, NIR-R highlighted a dark cuff border of the arteriolar vessel wall at the site of the posterior complicated RAM. These data were obtained rapidly with high reproducibility. We could hypothesize that the grayish aspect of the cuff in infrared imaging is due to the accumulation of fibrin, hyaline, and cells in the vessel walls, as described in the histological analysis [6]. This hypothesis is highly speculative and imaging-histologic correlation is needed.

We believe this image modality is another important tool that could help localize premature RAM, guide patient workup to rule out or control high blood pressure, and educate the patient about their potential retinal complications. Images such as those of this manuscript are acquired using direct, confocal scanning laser ophthalmoscopy, $\lambda = 815$ nm, $30 \times 30^\circ$ field of view, commercially available in combination with the OCT system (Spectralis). Alternatives to scanning laser ophthalmoscopy that utilize infrared imaging are also available and future tests are needed to verify its usefulness in this vascular disease.

The retrospective incidental findings suggest that NIR-R is a noninvasive method that could contribute to the detection of early damage of the arterial wall that may predict arterial aneurysm formation in hypertensive patients. This guidance could be used by the physician to closely monitor high-risk patients to prevent complications.

Statement of Ethics

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. There was no need for Ethics Committee approval.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

A.Z., A.F., M.P.C., T.Z., and M.C. were involved in data analysis and writing and reviewing the paper. A.Z. and A.F. were also involved in data acquisition. All authors read and approved the final manuscript.

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