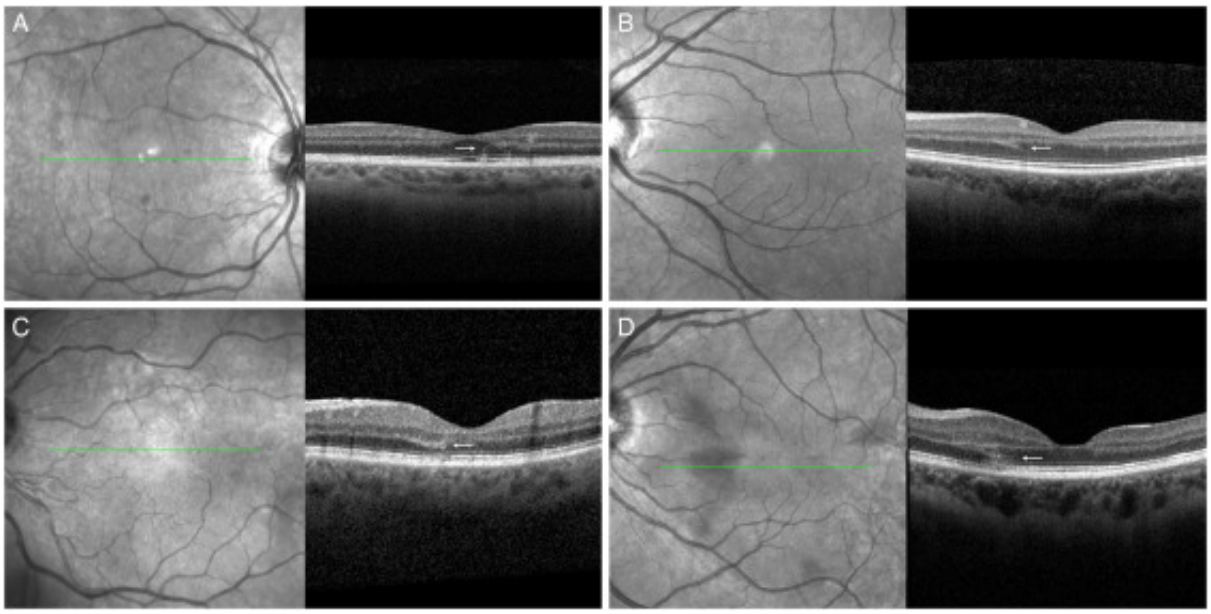
Optical coherence tomography angular hyperreflectivity as an early sign in acute macular neuroretinopathy



Acute macular neuroretinopathy (AMN) is characterized by acute paracentral scotomas secondary to focal ischemia of the deep capillary plexus (DCP) of the retinal circulation. Characteristic optical coherence tomography (OCT) features include hyperreflectivity spanning the outer plexiform layer (OPL) to the interdigitation zone (IZ) with eventual thinning of the OPL, outer nuclear layer (ONL), ellipsoid zone (EZ), and IZ. The lesion is also hyporeflective on near-infrared reflectance imaging.

Herein we present several cases of curvilinear hyperreflectivity in the Henle fibre layer (HFL) demonstrated on OCT, which abuts the area of ONL hyperreflectivity of the AMN lesion. This has been described as the angular sign of HFL hyperreflectivity (ASHH) and can be seen in several macular diseases, including AMN, acute posterior multifocal placoid pigment epitheliopathy, retinal vascular diseases,

and photic maculopathy. We believe that ASHH in AMN is a result of ischemic injury to photoreceptor axons leading eventually to a Wallerian-like degeneration of photoreceptor cell bodies, a hypothesis that is consistent with the retrograde pathway of photoreceptor disruption described by Ramtohul et al. The resulting axonal edema manifests as hyperreflectivity in the HFL and quickly disappears, giving way to more classical AMN features, such as ONL hyperreflectivity and EZ and IZ attenuation. These cases suggest that identification of ASHH in the appropriate clinical context can lead to an earlier diagnosis of AMN.

A male in his thirties with a history of type 1 diabetes presented with a paracentral acute scotoma in his right eye. The best-corrected visual acuity (BCVA) was 20/20 in each eye. The intraocular pressure was normal bilaterally, and there were no anterior-chamber or vitreous cells in either eye. Dilated fundus examination of both eyes was grossly unremarkable. OCT of the right eye revealed 2 curved hyperreflective lines within the HFL (Fig. 1**A**). The linear hyperreflectance corresponded well to the location of his symptoms, even though there was minimal EZ or IZ disruption.

Fig. 1Optical coherence tomography images of curvilinear hyperreflectivities in the Henle fibre layer in our 4 patients (A–D, arrow).

A female in her forties with a history of attention-deficit hyperactivity disorder treated with amphetamine and dextroamphetamine presented with an acute paracentral scotoma in the left eye. The BCVA was 20/20 in both eyes. Posterior-segment examination demonstrated a paracentral brown lobular lesion in the left eye. A curvilinear hyperreflectance was noted in the OPL–ONL interface corresponding to her scotoma, with no EZ disruption (Fig. 1**B**).

A female in her sixties with a history of central serous chorioretinopathy in the right eye, hypothyroidism treated with levothyroxine, and type 2 diabetes presented with an acute

paracentral scotoma in the left eye. The BCVA was 20/30 in the right eye (baseline with the chronic central serous chorioretinopathy) and 20/20 in the left eye. Fundus examination of the left eye revealed a paracentral reddish-brown lobular lesion. A curvilinear hyperreflectance was noted in the OPL–ONL interface, along with mild EZ attenuation, both of which corresponded to the scotoma (Fig. 1**C**).

A female in her thirties with no medical history presented with an acute paracentral scotoma in the left eye immediately after a choking and coughing episode. The BCVA was 20/20 in both eyes. Posterior-segment examination revealed scattered deep intraretinal hemorrhages in the left eye. OCT showed a few scattered hemorrhages in the OPL–ONL interface and an area with curvilinear hyperreflectance overlying an area of EZ disruption corresponding to her scotoma (Fig. 1**D**).

We describe 4 AMN patients who presented early in the course of the disease with curvilinear hyperreflectivity in the HFL rather than more typical features on OCT imaging. This hyperreflectivity has recently been described as ASHH. The HFL, which contains axonal connections between the photoreceptor cell bodies and the cells in the inner nuclear layer, is obliquely oriented due to the horizontal displacement of cells in the inner nuclear layer as the fovea develops. ASHH appears early in AMN (because axonal swelling is acute) and often fades prior to retrograde disruption of the ONL or EZ (Fig. 2**A, B**). Thus ASHH may occasionally be the only sign of AMN in the acute phase of the disease. ASHH is absent from classical descriptions of AMN because it fades before more typical OCT features, such as ONL hyperreflectivity and EZ disruption, develop. The evolution of the disease in the first patient we described likely represents a brief transition point when both ASHH and ONL hyperreflectivity are present, but EZ disruption has not yet occurred. Besides being missed in AMN patients who present later in their

disease course, ASHH also may be missed because of the typical horizontal or vertical orientation of rasters on standard horizontal OCT B-scans. Because ASHH has a radial orientation corresponding to the anatomy of the HFL, radial B-scans sometimes can detect this sign when horizontal scans do not (Fig. 2**C, D**).

Fig. 2Early presentation of the angular sign of Henle fibre layer (HFL) hyperreflectivity in acute macular neuroretinopathy and importance of radial cuts on optical coherence tomography. (A) Angular sign of HFL hyperreflectivity (ASHH) in our third patient with only subtle ellipsoid zone (EZ) disruption. (B) Outer nuclear layer thinning and more pronounced discontinuity of the EZ, consistent with classic features of acute macular neuroretinopathy and resolution of ASHH, are seen in the same patient at 1-month follow-up. (C) No apparent ASHH in our second patient at 2-week follow-up (inset: presentation) on a horizontal B-scan, with ASHH seen on a radial cut (D). Regions of current and prior ASHH are denoted by dashed rectangles.

The early appearance and location (in the HFL) of ASHH, as well as the lack of apparent retinal pigment epithelium injury in AMN, suggest that ASHH in AMN represents retrograde photoreceptor injury from DCP ischemia, which propagates along the HFL and triggers photoreceptor cell body death, eventually leading to ONL thinning. A similar curvilinear hyperreflectivity also may be observed in photic maculopathy. However, photic injury likely proceeds in an anterograde fashion, with thermal absorbance by the retinal pigment epithelium leading to heat injury to the photoreceptor cell bodies. This then leads to photoreceptor degeneration and downstream axonopathy, which manifests as HFL hyperreflectivity. Thus it is rare to see ASHH in early photic injury *without* accompanying EZ disruption, whereas ASHH in AMN will appear before EZ disruption.

In conclusion, we present several cases demonstrating that ASHH in AMN may be more common than is currently recognized for at least 2 reasons. First, ASHH may occur early in the disease process and fade rapidly. Second, the characteristic hyperreflectivity may be missed on standard OCT rasters, which are oriented horizontally

rather than parallel to the radially oriented HFL. ASHH likely results from DCP ischemia, triggering a photoreceptor axonopathy that progresses in retrograde fashion, akin to axonal Wallerian degeneration, to eventually involve photoreceptor cell bodies. Subsequently, ASHH fades, and the more typical features of AMN, including ONL hyperreflectivity and EZ and IZ loss, manifest. While ASHH commonly may be associated with AMN, we suggest that the 2 terms are still distinct. ASHH is an OCT description of HFL swelling that may have many etiologies, whereas AMN is a specific cause of ASHH originating from DCP hypoperfusion. By recognizing that early AMN often may involve isolated ASHH, clinicians will be more equipped to recognize a common cause of acute scotoma at the first visit.

Footnotes and Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this correspondence.

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Figures

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