Choroidal Blood Flow in AMD

In a recent article in this journal, Grunwald et al. quantified foveolar choroidal blood flow using a Laser Doppler flowmeter in patients with nonexudative age-related macular degeneration (AMD). They found that choroidal blood volume and choroidal blood flow in patients with AMD were significantly reduced. However, they found no statistically significant difference for the choroidal blood velocity. In interpreting the results of this study, it has to be kept in mind that laser Doppler flowmetry cannot be used for absolute blood flow measurements because of uncertainty in knowing the volume sampled by the incident laser light and the multiple light-scattering properties of tissue. This results in a lack of specificity in volume examined that is caused by the variable penetration depths of the laser. It is known that eyes with AMD display a thick layer of basal laminar (linear) deposit (BLD). It cannot be excluded that this thick layer of tissue—with unknown optical properties—overlying and within Bruch’s membrane affects the sampled volume and alters the scattering behavior of the laser light and thus changes the “Doppler shift power spectrum.” This may, after all, result in an inaccurate measurement of flow, which is estimated using the “velocity” and the “volume.”

The results of the Grunwald et al. study also have to be interpreted in the light of histologic and ultrastructural findings in eyes with AMD. Histologic studies have not demonstrated consistent alterations of the choriocapillaris in early stages of AMD. The outer portion of the neurosensory retina inner nuclear layer, which is nourished from the choriocapillaris, is histologically unaltered in most eyes with AMD. Therefore, it seems that insufficiency of the choriocapillaris blood supply is not the primary factor for development of AMD. However, in some instances, when we compared eyes with exudative and nonexudative AMD from an eye bank with those from an age-matched control group, we found an increase in total luminal area of the capillaries of the choriocapillaris in the eye bank eyes.

Several authors have postulated choroidal perfusion abnormalities in patients with AMD. However, those abnormalities either may represent a true alteration of the choroidal perfusion or may be simply a result of increased fluorescein blockade from deposits in Bruch’s membrane, specifically BLD. Holz et al. reported that slow choroidal filling on fluorescein angiography is a risk factor for the development of geographic atrophy. However, these findings can be interpreted in two ways: either there is real ischemia or a high degree of BLD has caused pseudoischemia by blockage of the choroidal fluorescence, and it is the BLD that is the true risk factor for the development of geographic atrophy. Indocyanine green angiography may be a better method for assessment of choroidal hemodynamics, because this method may not be affected as much by Bruch’s membrane deposits as fluorescein angiography, and in such a study, no change in the filling time of the choroid in patients with AMD could be found.

Another interesting facet of choroidal blood flow was introduced by Friedman et al., who proposed that the sclera in eyes with AMD becomes increasingly rigid and noncompliant, thus increasing the resistance of venous outflow and inducing an elevated venous pressure with distortion of choroidal veins. However, Kiel and Reiner calculated a decrease in total choroidal vascular resistance in eyes with AMD based on our published data. They concluded that this decrease would be associated with an increase in choroidal blood flow.

In summary, it can be stated that the level of choroidal perfusion in AMD is still unresolved. Furthermore, even with proof of a change in choroidal perfusion in patients with AMD, it still may be difficult to determine whether these changes are primary pathogenic factors or are secondary in nature.

References


Correspondence: Christoph W. Spraul, Department of Ophthalmology, Eye Hospital and Clinic, University Ulm, Prittwitzstrasse 43, D-89075 Ulm, Germany.