Retinal Arterial Macroaneurysm: A Brief Review

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Abstract
Retinal arterial macroaneurysms (RAMs) are acquired, focal dilatations of retinal arterioles. They result from progressive thinning and a decrease in elasticity of the retinal arteriole wall due to cardiovascular disease and can be either fusiform or saccular in shape. Retinal arterial macroaneurysms are most commonly seen in elderly females. Although most RAMs spontaneously involute, they can lead to vision-threatening complications such as vitreous hemorrhage and macular edema. This paper reviews the etiology, characteristics and management of RAMs.

Introduction
Retinal arterial macroaneurysms (RAMs) are acquired, potentially vision-threatening focal dilations of the larger retinal arterioles, most commonly occurring in elderly females. Retinal arterial macroaneurysms are associated with cardiovascular disease, most commonly systemic hypertension. The presentation of RAMs is variable, which may make the diagnosis challenging. Herein, we review the clinical characteristics and management of patients with RAMs.

Etiology
Up to 75% of cases of RAMs are associated with systemic hypertension. A RAM usually arises in the sclerotic phase (i.e., endothelial damage, intimal thickening and vessel narrowing) of hypertensive retinopathy. Through aging, atherosclerosis, and systemic hypertension (with an increase in hydrostatic pressure) there is progressive atrophy of the muscular layer of the arteries leading to thinning of the vessel wall, a decrease in arterial elasticity, and focal arterial dilation. The focal nature of RAMs may be due to previous retinal emboli or thrombosis at these sites.

Clinical Characteristics
The mean age of patients with a RAM ranges from 66 to 74 years; 70% of cases occur in women and 90% of cases are unilateral. The clinical presentation of RAMs is variable, and this can pose a diagnostic challenge. While patients with RAMs may be asymptomatic and the lesions found on routine examination, up to 75% of RAMs are misdiagnosed upon first presentation, often due to a presumption that an associated macular hemorrhage arises from a choroidal neovascular membranes or a retinal vein occlusion.

Retinal arterial macroaneurysms are usually found at arteriovenous crossings within the first three bifurcations of the central retinal artery, typically at arteriovenous crossings or the bifurcation itself (Figure 2). At crossing sites and bifurcations, there is a lack of the adventitial layer which reduces structural support leaving them prone to aneurysm formation. They can be classified as either fusiform (cuffed) or saccular (blowout) through angiography. A fusiform RAM is a focal, circumferential widening of the retinal artery, whereas a saccular RAM is a localized outpouching of the arterial wall, most often on one side of the artery only.

Figure 2. Retinal arterial macroaneurysm within superior temporal arcades with subretinal hemorrhage and scattered exudates (Courtesy, MRCOphth Atlas of Posterior Segment)
Most symptomatic RAMs occur in the superior temporal artery. Given further proximity from fixation, the less common but mostly asymptomatic RAMs are usually seen along the nasal arcades. Patients with RAMs can develop secondary macular edema and exudation. The exudates are typically in the macula or in a circinate pattern around the RAM (Figure 3). Hemorrhage from RAMs can present in multiple retinal layers – subretinal, intraretinal, preretinal and in the vitreous.

**Diagnostic Testing**

Given the variable presentation of RAMs, retinal imaging is often useful to confirm the diagnosis and monitor response to treatment. Color fundus photography can establish a baseline for future progression and/or resolution. Optical coherence tomography (OCT) can image the RAM lesion. An OCT scan through a RAM shows abnormal saccular expansion of arterial vessel walls with an enlarged lumen in the inner retinal layers; this causes associated elevation of the inner limiting membrane with a secondary shadowing effect of the deeper retinal layers (Figure 1). In addition, an OCT can characterize the extent of macular edema, exudate and hemorrhage and establish a baseline for future management. In a retrospective study, it was determined that the fluid from the RAM fills in the outer retinal layers (i.e., subretinal space) causing a serous retinal detachment. An important diagnostic aid is fluorescein angiography (FA). On FA, the RAMs appear as bright, hyperfluorescent lesions. More recently, OCT-angiography (OCT-A) has been used as a non-invasive means of diagnosing RAMs. The OCT-A can evaluate the structure and function of the inner and outer retinal vascular plexus, as well as the choroid. On OCT-A, a reduced signal flow through the suspected RAM is a characteristic finding; a decrease in signal flow is typical of an involuting RAM. The OCT-A can be used as a diagnostic aid, although motion artifact and signal attenuation can cause the quality of the image to degrade. Thus, performing an FA is the most important diagnostic aid for RAMs.

**Management**

The management of RAMs should address both ocular and systemic disease. The patient’s symptoms (most commonly vision loss) and the appearance and associated complications of a RAM will usually dictate the best plan of care. The vision loss is secondary to macular hemorrhage and/or edema, the most common side effects from RAMs. Most RAMs follow a benign course of thrombosis, fibrosis and spontaneous resolution; with best corrected visual acuity achieved in 2-3 months from onset to resolution of RAM. Hence, in asymptomatic RAMs without macular hemorrhage or exudates, observation every 6 months is recommended. In RAMs without macular involvement and with no immediate threat to vision, observation in 1 month followed by every 1-3 months is recommended.

In symptomatic patients, the treatment depends upon the specific complication. In patients with secondary macular edema, the use of anti-vascular endothelial growth factor (VEGF) agents is an option. The putative mechanism involves decreasing production of VEGF through the reduction of nitric oxide, which causes vasoconstriction of the retinal arterial and a decrease in macular edema. Another treatment
option is retinal laser photocoagulation. The photocoagulation can directly target the macroaneurysm or be applied indirectly around the lesion.\textsuperscript{1,4,6,15} In both cases, the goal is to induce involution of the lesion and decrease the associated macular edema.\textsuperscript{1,4,6,15} Possible complications of the laser treatment include arteriolar occlusion, traction and retinal scarring.\textsuperscript{2,9-15} An alternative treatment is subthreshold laser photocoagulation; subthreshold laser utilizes retinal hyperthermia just below the cell death threshold, thus reducing the thermal stress on the retina, lowering the risk of associated complications by reducing the duration of laser exposure and effects by the cell death threshold.\textsuperscript{2,10,11}

In patients with a non-clearing vitreous hemorrhage, a pars plana vitrectomy may be warranted.\textsuperscript{1,2,5,7} Patients with mild vitreous hemorrhage (and an adequate view of the RAM) that fails to clear with observation, anti-VEGF and/or laser photocoagulation are good treatment options.\textsuperscript{1,2}

Patients with RAMs also should be evaluated by their primary care providers to address systemic hypertension and other cardiovascular risk factors and lower their risk of associated cardiovascular complications.\textsuperscript{4,6}

\textbf{Conclusion}

The clinical presentation of RAMs is variable, and management options – including observation, laser photocoagulation, anti-VEGF therapy and retinal surgery – will depend on a patient’s symptoms and the nature of any associated complications. It is also imperative that patients with RAMs be evaluated by their primary care provider to ensure that any associated cardiovascular disease is being optimally treated.

\textbf{References}


