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REVIEW

Retinal arterial macroaneurysm

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Abstract

Retinal arterial macroaneurysms (RAMs) are acquired focal round fusiform dilatation of the retinal arterioles that occur at branch points or arteriovenous crossing. RAM most commonly affects the superotemporal retinal artery. Although RAM is usually a self-resolving condition in which most patients are asymptomatic, acute vision loss can occur from exudation, edema, retinal hemorrhage, or vitreous hemorrhage. Treatment should consider the lesion characteristics of RAM. Observation, antiangiogenics, and surgical intervention are current options to manage symptomatic RAM.

Keywords: RAM; retinal arterial macroaneurysm.

Retinal arterial macroaneurysm (RAM) is an acquired aneurysmal dilation of the retinal arteriole wall that most commonly arises within the first three orders of arterial bifurcation. Although a rare entity, RAM can mimic other retinal vascular diseases, such as diabetic retinopathy, Coats' disease, and cavernous hemangioma. A thorough history and ocular examination is imperative in the work-up and diagnosis of RAMs. This review highlights the clinical characteristics, current management, and treatment of RAM.

Clinical Characteristics

The first description of RAM was by Loring in 1880 when he described an unusual bulge of the inferotemporal retinal artery in an otherwise healthy 25-year-old man.[1] Nearly 100 years later, Robertson described the natural history of RAM and defined the disease as a distinct clinical entity.[2]

RAM is characterized by the fusiform or saccular dilation of the retinal arteriole. RAM arises at a branch point or arteriovenous crossing within the first three orders of arteriole bifurcation. The superotemporal artery is most commonly involved. Although case reports of RAM occurring in patients as young as 16 years of age have been described, RAM typically affects women 60 to 70s years of age.

Major risks factors for RAM include hypertension (up to 75% of RAM patients have systemic hypertension), atherosclerotic disease, and serum lipid abnormalities.[3] The patients with RAM should be screened for cardiovascular diseases. RAM is typically unilateral and singular in presentation. In up to 20% of cases, RAM are multiple and in 10% of cases RAMs are bilateral.[4]

Although patients with RAM are often asymptomatic, patients can present with central vision loss from exudation,

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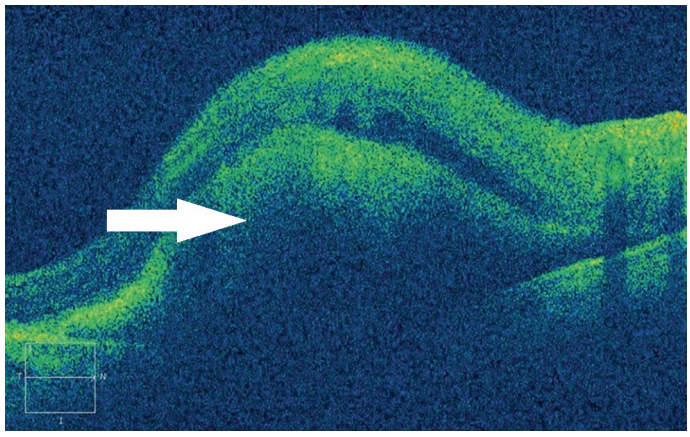

Fig. 1. Optical coherence tomography showing large subretinal hemorrhage (white arrow) associated with a retinal arterial macroaneurysm.

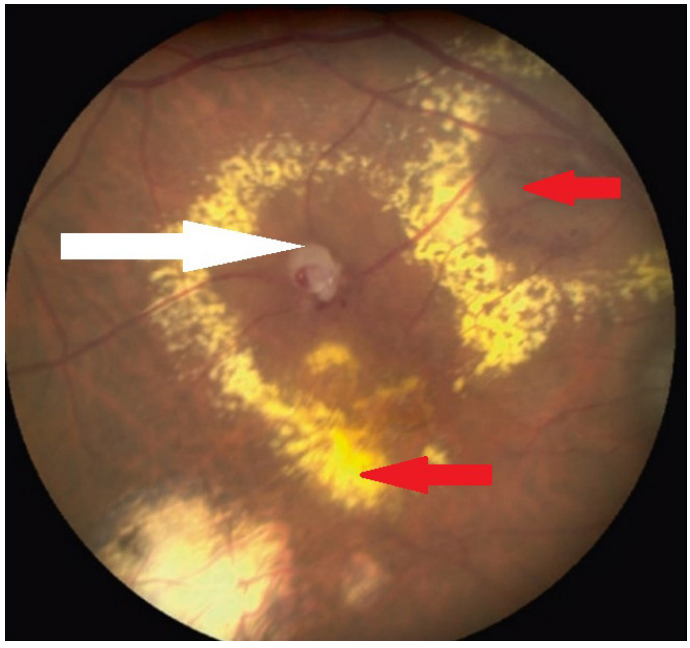

Fig. 2. Retinal arterial macroaneurysm (white arrow) with surrounding circinate hard exudate and lipid (red arrows).

edema, or hemorrhage in the macula secondary to RAM. Hemorrhage surrounding the macroaneurysm is common and can be seen in up to 50% of eyes.[4] The retinal hemorrhage from RAM can be preretinal, intraretinal, or subretinal (Fig. 1). Hemorrhage from RAM that affects all retinal layers is termed hourglass hemorrhage and occurs in about 10% of cases.[5] It is common for RAM to be surrounded by circinate hard exudates or for the exudates to be found distal to RAM (Fig. 2). In rare cases, a serous retinal detachment can be found surrounding RAM. Other microvascular changes associated with RAM include enlarged artery to artery anastomosis, capillary dilation, non-perfusion, and enlargement of the capillary free zone around the RAM.

Histological studies of RAM show an abnormal clot formation within the vessel wall of the retinal arteriole. The thrombus is comprised of hyaline, fibrin, and foamy macrophages.[6] The focal plaque leads to damage of the vessel wall and localized ischemia which results in collagen remodeling and pathologic focal vessel wall dilation that characterizes RAM.

Imaging Characteristics

On early phase fluorescein angiography, RAM shows uniform filling followed by mild to absent vessel staining or extensive vessel damage on late phase fluorescein angiography (Figs. 3 and 4). The absence of dye or delayed dye filling can indicate the spontaneous involution of RAM. Because fluorescein angiography may fail to detect RAM in the presence of overlying hemorrhage or exudate, indocyanine green angiography (ICG), which uses an absorption and emission spectra in the near-infrared range, can be used. With its greater penetration of near-infrared light,[7] ICG can show round hypercyanescent focal spots adjacent

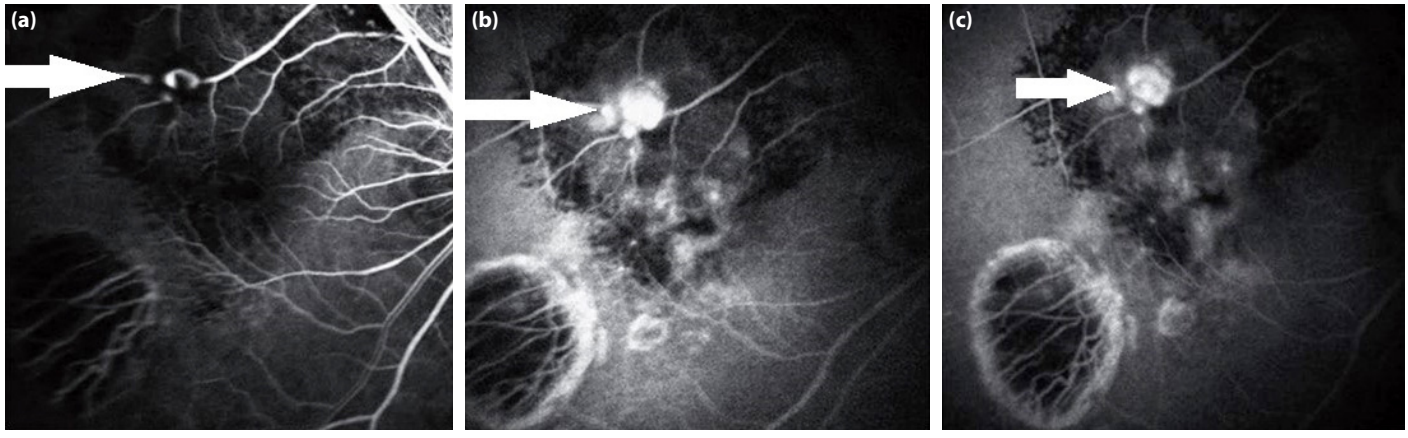

Fig. 3. Fluorescein angiography showing progressive uniform filling of a retinal arterial macroaneurysm (white arrow) at the early **(a)**, middle **(b)**, and **(c)** late phase.

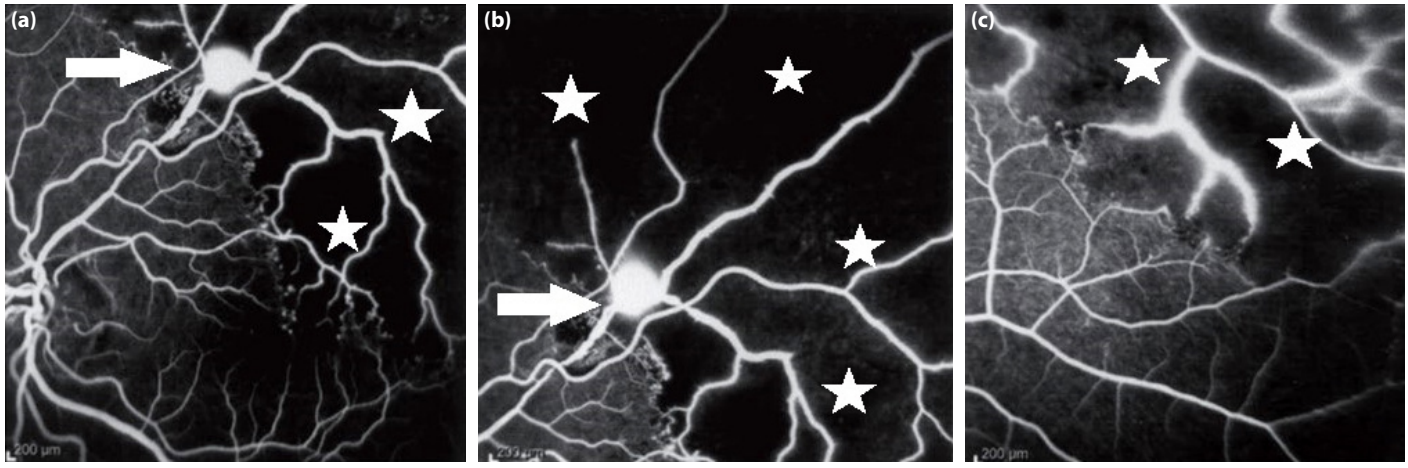

Fig. 4. **(a-c)** Fluorescein angiography showing surrounding non-perfusion (*) and microaneurysms around the retinal arterial macroaneurysm (white arrow).

to retinal arterioles, which are characteristic of RAM. In addition, ICG videoangiography can be used to demonstrate pulsations of RAMs.[8]

Management

Observation

The natural history of RAM is spontaneous fibrosis and involution.[4] Observation is therefore appropriate in asymptomatic patients or patients who have excellent visual acuity.[2] In the presence of moderate to severe vision loss, especially in the presence of hemorrhage and exudation, there is concern for hemorrhage-induced toxicity to the photoreceptor cells. The most common sequelae of RAM are macular edema. Macular edema can cause permanent damage to the macular structures from the chronic exudation of lipids.

Laser Photocoagulation

Many types of lasers have been advocated in select cases of RAM. Yellow dye laser has been applied to treat the retina immediately surrounding RAM and has been considered advantageous to other lasers due to its minimal damage to underlying epithelium.[9] For preretinal macular hemorrhage, Nd:Yag laser photodisruption of the hyaloid and release of the trapped preretinal hemorrhage has been shown to have good visual outcomes by disrupting the internal limiting membrane and allowing quicker evacuation of the trapped hemorrhage into the vitreous.[10] Nd:Yag laser photodisruption of the internal limiting membrane is used with caution as complications can include non-clearing vitreous hemorrhage, macular hole, and retinal detachment.[11,12]

Retinal Surgery and Anti-vascular Endothelial Growth Factors

The visual outcomes following pars plana vitrectomy treatment for vitreous hemorrhage from a ruptured macroaneurysm have been variable. Factors associated with good visual outcomes were cases in which the hemorrhage was localized to the vitreous cavity or sub-internal limiting space. The presence of submacular hemorrhage portended poorer vision.[13] Symptomatic macular edema and vitreous hemorrhage have also been treated with intravitreal anti-vascular endothelial growth factor, which has been shown to expedite resolution of the vitreous hemorrhage.[14] The visual improvement from anti-vascular endothelial growth factor treatment, however, has been variable. In one retrospective study, no significant difference was found in the final central macular thickness or visual acuity.[14] In a separate retrospective study, anti-vascular endothelial growth factor treatment of RAM was correlated with decreased central macular thickness and improvement in visual acuity, but this response was dependent on RAM size and distance to the macula.[15] In another prospective study, monthly injections of intravitreal bevacizumab resulted in anatomical visual acuity improvement. At 6 weeks following 2 intravitreal injections of bevacizumab, there was closure of RAM in 94% of patients. At 4 weeks following the third intravitreal injection of bevacizumab, 100% of patients showed complete resolution of macular edema, which corresponded with significant improvement in visual acuity.[16] There is some thought that anti-vascular endothelial growth factor may stimulate the resolution of macular edema associated with RAM (Fig. 5) through its effects on the vascular endothelium, stimulating production of nitric oxide from the endothelial cells which then activate

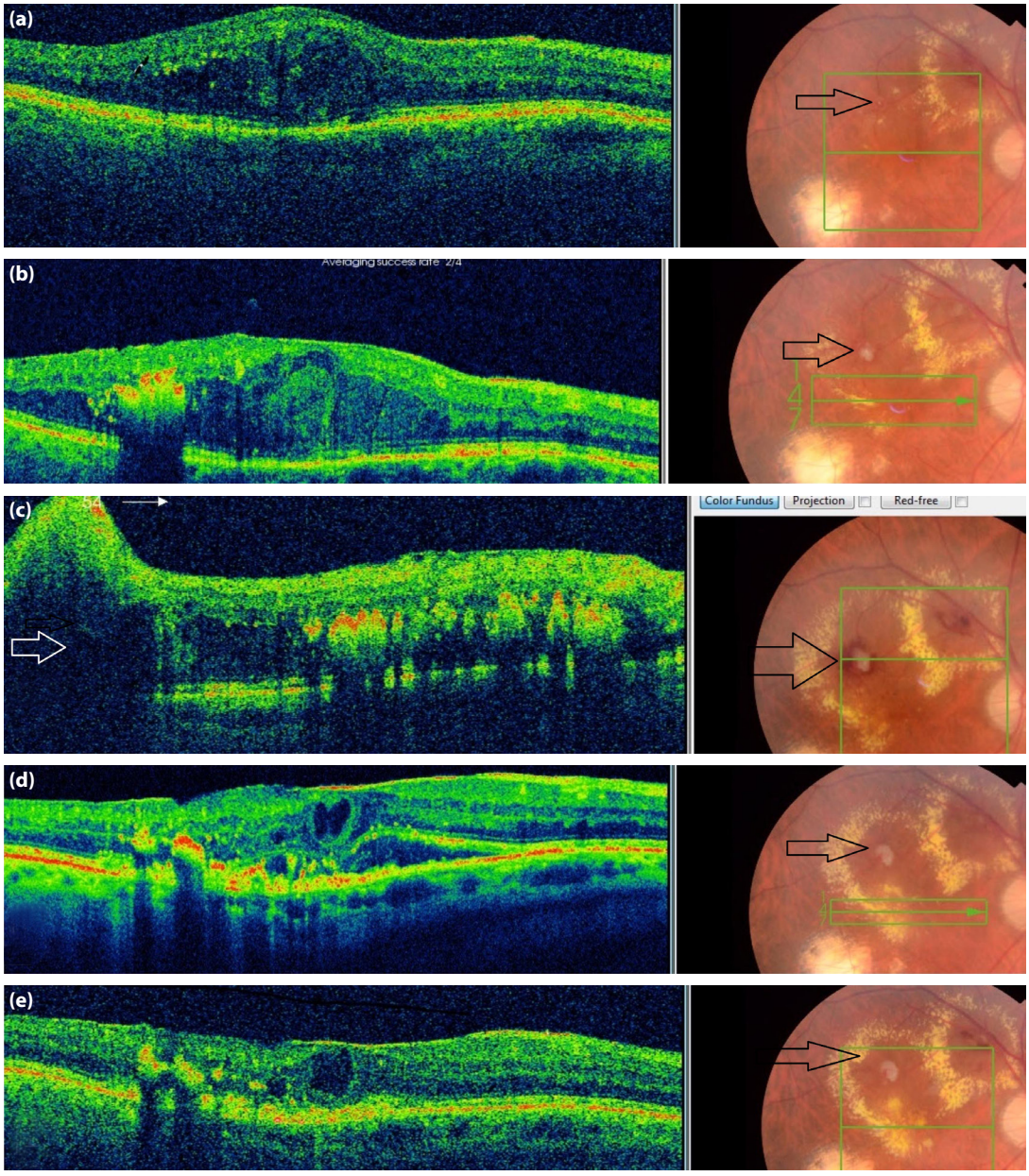

Fig. 5. Superotemporal RAM with exudation (hollow arrows). Visual fluctuated from baseline of 20/60 and central macular thickness of 517 micron **(a)** to final of 20/200 and thickness of 308 micron **(e)** following 13 injections with transient visual improvement after each injection. Serial horizontal macular OCT scans showing diffuse macular edema with initial leakage from the superior RAM **(a)** with gradual enlargement **(b)** and subsequent leakage of hard exudates from a superotemporal RAM **(c)** followed by perianeurysmal leakage of hemorrhage **(c)**. **(a)** Baseline. **(b)** 3 months follow-up. **(c)** 9 months follow-up. **(d)** 13 months follow-up. **(e)** 14 months follow-up.

the coagulation cascade and vasoconstriction.[14,15] Other surgical techniques have yielded variable results. Small case series of surgical pneumatic displacement with tissue plasminogen activator and SF6 gas have been tried but not recommended due to a high incidence of subsequent vitreous hemorrhage requiring vitrectomy.[17] The excision of RAM with retinal scissors and diathermy has also been described in a limited case series of 2 patients.[10]

Conclusion

RAM generally has a good prognosis and is a self-resolving condition. The most patients are asymptomatic, but acute vision loss can occur from exudation, edema, retinal hemorrhage, or vitreous hemorrhage. Treatment should consider the lesion's characteristics. Observation, antiangiogenics, and surgical intervention are current options to manage symptomatic RAM.

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