

RETINAL EMBOLECTOMY: WHY, WHEN, HOW?

For some patients with BRAO, this procedure can provide significant benefit.

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Branch retinal arterial occlusions (BRAOs) account for approximately 40% of all retinal arterial occlusions,^{1,2} and a displaced embolus is the most common etiology.³

Surgical embolectomy is a controversial therapy for arterial occlusions, but, in cases in which the fovea is threatened and no patent cilioretinal artery exists, embolectomy may be the only efficacious management available.

Surgical embolectomy was first successfully attempted by Peyman and Gremillion in 1990.⁴ To date, a total of 12 patients have undergone surgical embolectomy⁴⁻⁸; however, due to the common complication of vitreous hemorrhage present in all previously published cases, no clear choice of surgical technique appears in the literature.

This article addresses several aspects of surgical embolectomy, including why it should be performed and when the procedure is appropriate to perform. We also present our own technique for isolating and retrieving an embolus in acute cases of fovea-threatening symptomatic BRAO.

WHY RETINAL EMBOLECTOMY?

Although visual acuity may remain static in most patients with BRAO, a subset of patients will experience progressive and permanent visual decline and visual field deficits.² Patients in this subset most likely have no patent cilioretinal artery or have BRAO that involves the fovea. Given the lack of efficacy associated with noninvasive treatment options for arterial occlusions,⁹ surgical embolectomy is an alternative invasive option for fovea-threatening acute arterial occlusions.

Due to the acute ischemic insult of arterial occlusion, prompt reperfusion is paramount in order to maximize visual benefit.³ Conservative noninvasive treatment options, such as lowering intraocular pressure (IOP) or use of hyperbaric oxygen, have limited efficacy.⁹ More invasive options such as intraarterial tissue plasminogen activator (tPA)

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similarly offer significant adverse events with no treatment benefit.¹⁰ Transluminal Nd:YAG laser has been used to photodisrupt obstructive arterial emboli with promising visual outcomes. However, significant vitreous hemorrhage, collateral tissue damage, and the potential for embolus fragmentation remain.¹¹⁻¹³



AT A GLANCE

- Surgical embolectomy is a viable technique for patients with acute fovea-threatening arterial occlusions without a patent cilioretinal artery.
- The authors' technique minimizes the risk of vitreous hemorrhage with careful dissection of the vascular adventitial sheath and isolation of the embolus.
- Preoperative clinical considerations, including case selection, are key to the success of the procedure.

WHEN IS RETINAL EMBOLECTOMY APPROPRIATE?

Surgical embolectomy is a controversial technique that may be of limited benefit in cases of stationary peripheral BRAO. However, when a BRAO threatens the fovea and there is no patent cilioretinal artery to offer collateral blood flow to the fovea, surgical embolectomy provides a viable intervention to help prevent possible compromise of the central macula. Analogous to operating on a patient with good central vision and a fovea-threatening macula-on rhegmatogenous retinal detachment, identification of at-risk patients with a BRAO and no patent cilioretinal artery can allow for the potential benefits of retinal embolectomy.

The following points should be considered with regard to surgical embolectomy technique:

- Case selection is critical. Only patients with fovea-threatening BRAO without a patent cilioretinal artery should be considered for surgery.
- Presentation and invasive management should be conducted within 24 hours of onset of visual symptoms to reduce the likelihood of irreversible ischemia.
- The natural history and prognosis of retinal artery occlusions should be discussed with the patient preoperatively. Only after a conversation about the risks and benefits of the surgery has taken place should appropriate consent be obtained and surgical embolectomy planned.

PERFORMING RETINAL EMBOLECTOMY

Our technique for retinal embolectomy employs a small-gauge pars plana vitrectomy (PPV) approach to retrieve the arterial embolus under direct visualization (Video).



WATCH IT NOW

Retinal Embolectomy

Dr. Almeida provides step-by-step narration of the surgical technique for this procedure in a 49-year-old woman.

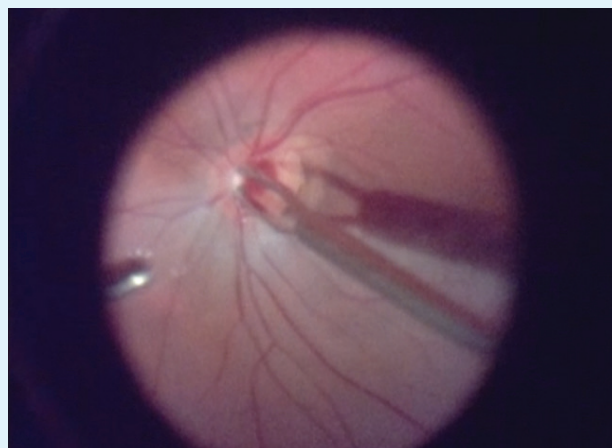
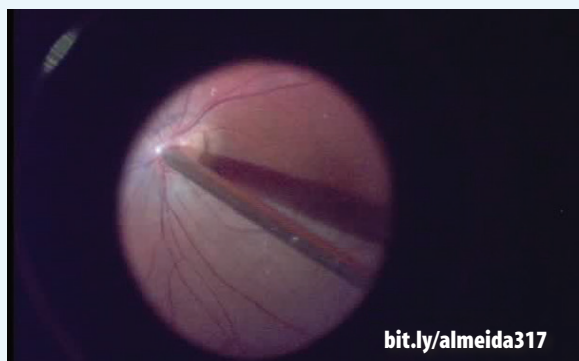


Figure 1. After core vitrectomy and induction of posterior vitreous detachment with the aid of dilute intravitreal triamcinolone acetate, the embolus at the proximal inferior arterial arcade is grasped with end-grasping forceps.

By carefully dissecting the overlying vitreous, retina, and vascular sheath, one is able to minimize the risk of vitreous hemorrhage, which has commonly plagued previous techniques of retinal embolectomy. The steps of our technique are outlined below.

- A standard three-port PPV is performed. A press-on macular lens is used to provide high magnification and enhanced stereopsis.
- Dilute 50% intravitreal triamcinolone acetonide is injected into the vitreous cavity to aid in inducing a complete posterior vitreous detachment and to facilitate removal of any unopacified vitreous overlying the embolectomy site.
- Meticulous mechanical dissection of any remnant vitreous strands overlying the occlusion site is performed to ensure subsequent successful dissection of the vascular adventitial sheath.
- Once all vitreous is removed from the embolus site, a 25-gauge microvitorectinal (MVR) blade is used to carefully dissect the vascular sheath with longitudinal incisions along the plane of blood vessel flow. This dissection is performed until the wall of the arteriole is carefully and completely (ie, to full thickness) incised. During this part of the procedure, the infusion pressure is temporarily elevated to between 50 mm Hg and 60 mm Hg to minimize risk of hemorrhage.
- Intraocular end-grasping forceps are then used to grasp and remove the exposed embolus from the arteriole lumen.
- The IOP is slowly returned to normal in incremental steps, and gas-fluid exchange is performed.

It should be noted that, if significant traction is encountered when trying to remove the embolus with forceps,

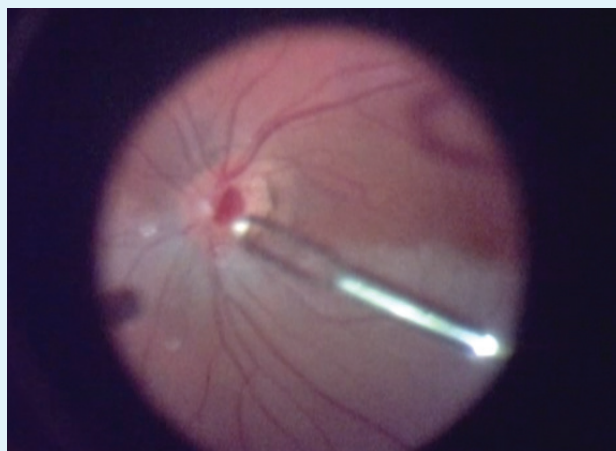


Figure 2. The embolus is successfully grasped from within the lumen after creation of a large incision parallel to the vessel and direction of blood flow, while hemostasis is achieved by temporarily elevating the intraocular pressure.

retinal hemorrhage may be encountered. This indicates that the adventitial sheath has not been fully dissected and that the arteriolar lumen has not yet been incised. If this is the case, we recommend reintroducing the MVR blade to further dissect and expose the embolus. With better exposure and minimal traction, the embolus can then be retrieved using microsurgical forceps (Figure 1). Careful dissection of overlying vitreous and the vascular sheath is key to exposing the embolus without vitreous hemorrhage, the occurrence of which can severely limit one's ability to visualize the subsequent embolus removal.

Mechanical displacement of the vitreous facilitates precise vessel incision and minimizes traction. This helps to prevent vessel rupture and vitreous hemorrhage during embolus retrieval, which has been present in all previously reported cases. The initial vessel wall incision may have to be extended in almost all cases. A larger incision parallel to the vessel and direction of blood flow can improve exposure and decrease the grasping force required to retrieve the embolus (Figure 2). Variations in IOP can cause either retrograde or anterograde embolus movement, an aspect that complicated the retrieval of the embolus in one previous report.⁷ To achieve optimal results, we recommend using valved cannulas and maintaining a steady but elevated IOP during vessel incision and embolus removal.

CONCLUSION

Thus far, we have been successful with our technique of embolus retrieval in acute cases of fovea-threatening BRAO. We have seen no occurrence of intraoperative vitreous hemorrhage with our technique and no cases of vision loss after the retinal embolectomy procedure.

Careful consideration of preoperative clinical matters, such as obtaining informed consent from the patient and selecting only fovea-threatening cases without a patent cilioretinal artery, are paramount to success.

Retinal embolectomy may be controversial, and it is indicated only in selected cases of patients with BRAO. However, with proper planning and a good technique, successful performance of this procedure can mean a world of difference to those experiencing progressive visual decline due to BRAO. ■

1. Brown GC, Shields JA. Cilioretinal arteries and retinal arterial occlusion. *Arch Ophthalmol*. 1979;97(1):84-92.
2. Hayreh SS, Podhajsky PA, Zimmerman MB. Retinal artery occlusion: associated systemic and ophthalmic abnormalities. *Ophthalmology*. 2009;116(10):1928-1936.
3. Hayreh SS. Acute retinal arterial occlusive disorders. *Prog Retin Eye Res*. 2011;30(5):359-394.
4. Peyman GA, Gremillion CM Jr. Surgical removal of a branch retinal artery embolus: a case report. *Int Ophthalmol*. 1990;14(4):295-298.
5. García-Arumi J, Martínez-Castillo V, Boixadera A, et al. Surgical embolus removal in retinal artery occlusion. *Br J Ophthalmol*. 2006;90(10):1252-1255.
6. Brunner S, Binder S. Surgical embolus excision in retinal artery occlusion — two case reports. *Acta Ophthalmol*. 2013;91(8):e652-653.
7. Ramchandran RS, Fekrat S. Embolectomy for branch retinal arterial occlusion. *Retin Cases Brief Rep*. 2010;4(2):116-119.
8. Matoni F, Hoffart L, Nadeau S, et al. Surgical embolectomy for central retinal artery occlusion. *Can J Ophthalmol*. 2013;48(2):e25-27.
9. Fraser SG, Adams W. Interventions for acute non-arteritic central retinal artery occlusion. *Cochrane Database Syst Rev*. 2009;CD001989.
10. Feltgen N, Neubauer A, Jurklics B, et al. Multicenter study of the European Assessment Group for Lysis in the Eye (EAGLE) for the treatment of central retinal artery occlusion: design issues and implications. EAGLE Study report no. 1. *Graefes Arch Clin Exp Ophthalmol*. 2006;244(8):950-956.
11. Mason JO 3rd, Nixon PA, Albert MA Jr. Trans-luminal Nd:YAG laser embolysis for branch retinal artery occlusion. *Retina*. 2007;27(5):573-577.
12. Opremacak E, Rehmar AJ, Ridenour CD, et al. Restoration of retinal blood flow via transluminal Nd:YAG embolysis/embolectomy (TYL/E) for central and branch retinal artery occlusion. *Retina*. 2008;28(2):226-245.
13. Hsu TK, Chen SJ, Lei J, et al. Embolus-induced branch retinal artery occlusion with a presenting best-corrected visual acuity of <6/12 and visual field defect: YAG embolectomy safely restores arteriolar perfusion and/or visual function. *Retin Cases Brief Rep*. 2013;7(3):210-216.

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