Diabetic retinopathy is one of the leading causes of blindness in the developed world, with a prevalence rate of 8.2% in the United States for vision-threatening diabetic retinopathy among patients with diabetes. Despite adequate medical management of diabetic retinopathy, 5% of patients show continued signs of progression and require surgical intervention.

**Indications for surgical intervention**

The indications for surgical intervention in patients with diabetic retinopathy are broad. The Diabetic Retinopathy Vitrectomy Study (DRVS) established the role of early surgery for patients with type 1 diabetes and vitreous hemorrhage. More recent data suggest that improvements in technique since the DRVS was completed have significantly improved visual outcomes in eyes with tractional retinal detachment due to both type 1 and 2 diabetes. Persistent non-clearing or recurrent vitreous hemorrhage should prompt consideration of vitrectomy depending on various factors, including degree of visual impairment, the visual status of the fellow eye, duration of hemorrhage, adequacy of previous panretinal photocoagulation (PRP), and presence of underlying tractional detachment involving or threatening the macula. The current trend is to observe patients with type 1 diabetes with new onset of vitreous hemorrhage for 1 month, and if no signs of clearing are seen, to proceed with surgery. Patients with type 2 diabetes can be monitored for a longer period of time for clearing, especially if adequate PRP has been performed and there are no signs of retinal detachment involving or threatening the macula. Dense premacular hemorrhage left untreated can result in macular tractional de-
tachment and should be promptly removed, ideally within 4 weeks, to attempt to preserve better visual acuity. Tractional retinal detachment (TRD) involving or threatening the macula is one of the primary indications for vitrectomy in diabetic retinopathy. The visual benefit of surgery for TRD is variable and depends on the degree of macular dysfunction. Extramacular TRD can be observed safely because it tends to progress slowly. In contrast, combined tractional-rhegmatogenous retinal detachments tend to progress rather quickly and should be monitored much more closely, with a lower threshold for taking the patient to the operating room regardless of the status of the macula. Severe active fibrovascular proliferation in spite of maximum PRP is often found in eyes with TRD and is also an indication for operative intervention.

Value of OCT outer layer grading: Predicting prognosis

Optical coherence tomography (OCT) may be more useful than fluorescein angiography (FA) for predicting final visual acuity after repair of TRD. Signs of loss of outer retinal structures, namely external limiting membrane and ellipsoid zone, on OCT portend a poorer prognosis and have been correlated with level of visual acuity. Large areas of ischemia on FA, especially enlargement of the foveal avascular zone, are also poor prognostic signs. The presence of either or both of these factors should be discussed with the patient preoperatively to help anticipate the likelihood of visual recovery with surgery.

Preoperative planning

Systemic blood sugar, blood pressure, and lipid control should be optimized prior to surgical intervention. Patients who do not have a primary care physician must be referred for evaluation and to start treatment. Adherence to medical therapy should be encouraged. Patients with poor blood sugar control despite compliance with their treatment regimen should be referred to an endocrinologist for further blood sugar management.

Intravitreal bevacizumab may be considered prior to surgery. Preoperative bevacizumab has been shown to reduce the amount and severity of intraoperative bleeding, leading to reductions in the number of instrument exchanges, the number of retinal tears, and surgical time. This is crucial because the most common complication in TRD repair is preretinal hemorrhage from attempts to remove fibrovascular membranes. Preoperative bevacizumab has also been shown to reduce the incidence of postoperative vitreous hemorrhage and improve final best corrected visual acuity at 6 months. The concern when giving bevacizumab preoperatively is that it may worsen the degree of tractional detachment by causing contracture of the membranes. This is especially true if the patient cancels surgery for any reason after getting the intravitreal injection. Therefore, clearing sick patients for surgery prior to injection with bevacizumab should be critical to prevent such a complication.

Intraoperative bleeding and postoperative persistent or recurrent vitreous hemorrhage were not found to be associated with the use of antiplatelet agents or anticoagulants; thus, they can safely be continued when needed. Posterior sub-Tenon’s block rather than a retrobulbar block should be considered when a patient is being treated with either of these agents.

Operative procedure

The basic goals of vitrectomy for proliferative diabetic retinopathy are removal of vitreous opacities, segmentation and delamination of areas of fibrovascular proliferation, retinal reattachment using tamponade if necessary, and prevention of recurrent active disease by performing PRP. The precise steps involved in each case are quite variable due to the large variability in surgical anatomy presented by each case.

The first step should be clearance of any vitreous opacity, followed by release of anteroposterior traction. Vitreous hemorrhage facilitates visualization of the posterior hyaloid face. If there is a subhyaloid hemorrhage, an opening can be created in the posterior hyaloid face to aspirate the blood and gain visualization of the underlying retina. Upon visualization of the posterior hyaloid face, the area of anteroposterior traction can be removed using the vitreous cutter. Some thought can be given to maintaining anteroposterior traction as an aid to keep areas of fibrovascular traction under tension, facilitating their removal; however, this technique has fallen out of favor, and in general all anteroposterior traction should be removed first.

The next step is to focus on areas of fibrovascular proliferation by first segmenting the membranes as much as possible using either the vitreous cutter or vertical scissors. A variety of techniques have been described for removal of the fibrovascular plaques, and multiple techniques may be required in each case to achieve a successful surgical result. Smaller-gauge instrumentation facilitates the segmentation of these membranes because the port of the cutter is closer to the tip of the instrument and the cutter can then be used in place of scissors. Smaller 27-gauge
probes provide better posterior pole dissection when bimanual techniques are not needed. However, extensive traction extending peripherally is better managed with 25- or 23-gauge instruments due to greater stiffness of the instruments. Visco dissection and proportional reflux hydrodissection with the vitrectomy instrument are techniques that have been described, but in general lifting and cutting are safer options than pushing one’s way through. After segmentation of areas of fibrovascular proliferation, attention is turned toward delamination of these plaques. Horizontal scissors and the smaller-gauge vitreous cutters can be used to elevate and remove these plaques from the surface of the retina. Vertical scissors can also be used to define a plane through the fibrovascular plaque; however, with larger plaques that are especially adherent, bimanual techniques are often necessary.

Bimanual surgery can be accomplished with the use of a chandelier such as the 25-gauge chandelier or the dual-port 29-gauge chandelier. Alternatively, one of the instruments used can be illuminated, such as a lighted pick in cases of very firmly adherent hyaloid or illuminated forceps. Both of these approaches for bimanual surgery have their advantages and disadvantages. The instruments used can vary significantly; however, for the most difficult cases, with active fibrovascular plaques completely covering the posterior pole, or cases in which bevacizumab cannot be injected preoperatively in sick patients with systemic vascular disease risk of stroke, myocardial infarction, and dialysis, one 20-gauge port may be required for the three-way tissue manipulator that can be used with smaller-gauge MPC pneumatic scissors or manual vertical and horizontal scissors. The 20-gauge port can then be partially sutured and surgery completed with valved cannulas. Recent advances in imaging technologies may allow safer dissection with the availability of intraoperative OCT. This can involve handheld OCT, microscope-mounted OCT, or even intraocular OCT probes.23-26

After successful segmentation and delamination of the fibrovascular membranes, attention is turned toward achieving retinal reattachment using a tamponade agent if necessary. Placement of a scleral buckle prior to vitrectomy for cases with a combined traction-rhegmatogenous etiology, especially with extensive peripheral traction in phakic patients, can aid greatly in relieving anterior vitreo retinal traction and achieving long-term retinal reattachment. If any breaks are found in the retina, complete removal of all traction adjacent to the break is required, and gas or silicone oil tamponade should be considered. Isolated peripheral or nasal traction not involving the posterior pole or macula may be left alone to prevent iatrogenic holes necessitating complete removal of all traction. Thought should be given to the status of the fellow eye in deciding on a tamponade agent. Monocular patients will be debilitated with the placement of gas into their only seeing eye, especially with a longer-acting agent such as perfluoropropane (C3F8). Any breaks should be treated with laser photocoagulation. Panretinal laser photocoagulation should be performed at the end of the procedure to prevent recurrent active proliferative disease, with careful attention to performing a full treatment using scleral depression if necessary. To prevent anterior hyaloidal fibrovascular proliferation, a curved endolaser probe should be used to safely reach the peripheral retina, especially in phakic patients.

Perfluorocarbon liquids may not be an option to flatten the retina in cases with posterior breaks or if there is residual traction on the retina; instead, a fluid-air exchange followed by laser would be the preferred option. Drainage of thick viscous subretinal fluid through a preexisting break is essential to help flatten the retina for endolaser. However, in the absence of breaks, subretinal fluid can be left in place and allowed to resorb spontaneously. As long as there are no open breaks or residual traction, the fluid will slowly resorb and vision will improve; in some cases, this process can take many months. With the wide availability of valved cannulas, it is now feasible to work under oil in recurrent detachments with residual or recurrent membranes. The addition of oil at the beginning of the procedure to maintain a slightly higher pressure keeps the eye stable for peeling of membranes. At the end of the procedure, the oil can be left in place, or in the presence of preretinal hemorrhage under oil, the oil can be replaced by fluid to aid in the removal of blood and, when needed, new silicone oil can be injected.

Intravitreal injection of bevacizumab may be considered at the end of the procedure in cases of very active disease with residual subretinal fluid. There have been reports showing reduction in the rate of postoperative vitreous hemorrhage and improvement of visual acuity at 6 months with injection of bevacizumab at the end of surgery for proliferative diabetic retinopathy.27

The role of vitrectomy in managing complications of proliferative diabetic retinopathy is unquestioned, and the indications for surgery have expanded to include those cases that were previously considered inoperable. With ever increasing instrumentation and techniques, early vitrectomy is
favored because it offers better long-term visual outcomes. Good preoperative planning combined with appropriate choices of gauges, instruments needed, and techniques used is critical to successful repair.

REFERENCES


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