

SURGICAL APPROACHES TO MANAGING PDR

Optimal results can be achieved with proper preoperative planning.

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The role of vitrectomy in the management of proliferative diabetic retinopathy (PDR) is complex and may include several of the following goals: removal of visually significant vitreous opacities, release of anteroposterior or tangential

traction, removal of fibrovascular proliferation (FVP), and use of endolaser photocoagulation. In this article, we offer some pearls to consider when planning one's surgical approach to the management of PDR (Figure 1).

WHEN IS SURGERY INDICATED?

Although management of PDR is often challenging, the art and science of vitreoretinal surgery is continually advancing, thanks to improved surgical instrumentation, visualization, and refined techniques. As always, careful preoperative planning is key to successful surgery.

Nonclearing Vitreous Hemorrhage

Vitreous hemorrhage (VH) is the most common complication of PDR, and surgery is indicated for patients with decreased visual acuity due to nonclearing VH. In 1985, investigators in the Diabetic Retinopathy Vitrectomy Study (DRVS) Group randomly assigned patients with new severe (visual acuity 5/200 or worse) VH to early (< 6 months) or deferred (> 12 months) vitrectomy. They determined that early vitrectomy was particularly advantageous for patients with type 1 diabetes.¹ Since then, practice patterns have evolved, with most surgeons preferring to intervene sooner than 6 months in any patient with severe nonclearing VH.²

In our practice, we typically observe a new VH for at least 2 months, then schedule vitrectomy if there are no signs of significant clearing. We consider earlier intervention for patients with bilateral visual impairment, iris neovascularization, inadequate prior panretinal photocoagulation (PRP), or with certain anatomic factors that favor surgical intervention (eg, dense premacular hemorrhage or coexisting traction retinal detachment [TRD] involving or threatening the macula). B-scan ultrasonography should be performed preoperatively

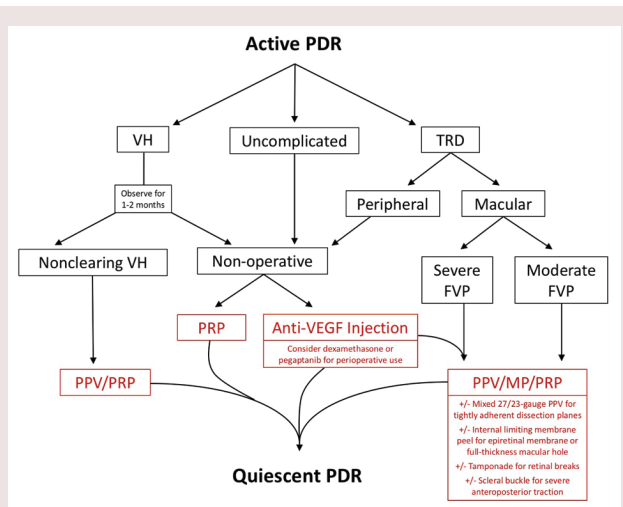


Figure 1. Indications for surgery in the management of patients with PDR.

Abbreviations: FVP, fibrovascular proliferation; MP, membrane peel; PDR, proliferative diabetic retinopathy; PPV, pars plana vitrectomy; PRP, panretinal photocoagulation; TRD, traction retinal detachment; VH, vitreous hemorrhage

to assess the extent of hyaloid separation and to look for areas of vitreoretinal traction.

In the event of a recurrent VH associated with intermittent or prolonged visual impairment, surgery may be recommended without the same period of observation. Recurrent VHs may occur even in patients with quiescent PDR, and widefield fluorescein angiography may be useful in assessing the degree of underlying PDR disease activity and the need for additional PRP.

The patient's preference for earlier visual rehabilitation or for deferred surgery should also influence surgical decision-making. If a patient's overall systemic disease is poorly controlled, we may opt to stabilize his or her condition medically before recommending surgery.

Tractional Complications

Another critical finding from the DRVS was the recognition of a trend favoring earlier surgical intervention as the severity

of neovascularization increases, particularly in the subgroups of eyes with severe and very severe FVP.³ This makes sense intuitively, as more mature neovascular membranes often contribute to the development of tractional complications.

FVP may coexist with a TRD or with schisis. Whereas a TRD involving or threatening the macula warrants timely surgical intervention,^{4,5} a peripheral TRD that does not threaten the macula may be safely observed.⁶ Combined tractional-rhegmatogenous detachments should undergo prompt surgery, even if they do not involve the macula, because of the risk of rapid progression.⁷

Vitrectomy may also be indicated for other tractional complications of PDR, including diabetic traction papillopathy,⁸ vitreomacular traction,⁹ and full thickness macular hole.¹⁰ Epiretinal membranes (ERMs) are commonly encountered in patients with PDR, and tangential traction on the fovea may result in metamorphopsia or may exacerbate diabetic macular edema (DME), causing a decline in visual acuity. Concurrent internal limiting membrane peeling can be considered in some cases to relieve extensive tangential traction associated with DME or overlying ERM.¹¹

SECRETS TO SUCCESS IN PDR SURGERY: PREOPERATIVE PLANNING

Planning and preparation for PDR surgery includes assessing the patient's systemic health status, providing counseling and obtaining informed consent for surgery, and setting the stage with pharmacotherapy. Before surgery begins, it is also important to think about the tools and techniques required to accomplish the goals of PDR surgery and to ensure that your OR team is prepared to provide the equipment you need.

Systemic Status

Diabetes is a systemic vascular disease associated with many end-organ complications, including myocardial

infarction and stroke. The estimated 5-year survival of patients undergoing diabetic vitrectomy is 68%.¹² In order to minimize the likelihood of arterial thromboembolic events during the perioperative period, a patient's glyce-mic index, blood pressure, and cholesterol levels should be optimized before surgery. Preoperative evaluation by an anesthesiologist should occur several days before surgery.¹³ Many patients with PDR have significant cardiovascular comorbidities and will need to remain on prescribed anti-coagulant and antiplatelet agents. For these patients, a peribulbar or sub-Tenon cut-down block can be administered rather than a retrobulbar block to mitigate the risk of retrobulbar hemorrhage. The risk of intraoperative or postoperative VH is not significantly increased by continuing anticoagulant and antiplatelet agents during the peri-operative period.¹⁴

Patient Expectations

It is difficult to predict a patient's visual potential before surgery, especially when visualization of the fundus is limited by media opacity. Preoperatively, optical coherence tomography (OCT) biomarkers such as external limiting membrane and ellipsoid zone integrity may help to predict postoperative visual acuity,¹⁵ but other factors, such as ischemic maculopathy, glaucoma, and ischemic optic neuropathy, may limit visual potential. Communicating with the patient about the complexity and unpredictability of diabetic surgery is crucial in setting realistic expectations.

Pharmacotherapy

Administration of a pharmacologic agent can help to achieve regression of PDR.¹⁶ This strategy may be pursued pre-operatively in order to minimize intraoperative bleeding and to alter the dissection planes encountered during surgery.

Anti-VEGF Agents

Preoperative injection of bevacizumab (Avastin, Genentech) 7 days before surgery has produced promising results.¹⁷ However, the so-called *crunch phenomenon*, whereby FVP contracts rapidly in response to anti-VEGF therapy, may result in worsening TRD.¹⁸ Anti-VEGF agents can also lead to the development of denser fibrotic connections between the retina and FVP, making it harder to separate tissue planes.¹³ Similar effects are seen with the anti-VEGF agents ranibizumab (Lucentis, Genentech) and aflibercept (Eylea, Regeneron).

In our practice, we generally avoid the use of these agents prior to surgery, as some patients may subsequently cancel surgery due to lack of transportation to receive their injections, worsening systemic disease, or delayed medical clearance. Pegaptanib (Macugen, Bausch + Lomb) is a first-generation anti-VEGF agent with lower specific binding affinity for VEGF. Thus far, our experiences using this drug prior to PDR surgery have been more positive than



AT A GLANCE

- Surgery may be indicated for complications of PDR including nonclearing vitreous hemorrhage and TRD.
- Preoperative administration of a dexamethasone implant may help to achieve regression of neovascularization and consolidation of fibrovascular proliferation.
- Surgeons can leverage the mechanical advantages of different cutters and secondary instruments by performing mixed-gauge vitrectomy for complex diabetic traction surgery.

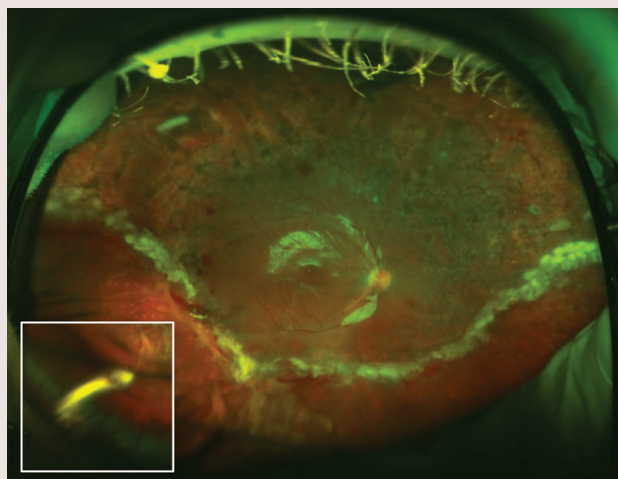


Figure 2. Quiescent PDR 4 weeks after repair of a TRD. A dexamethasone intravitreal implant 0.7 mg was injected preoperatively and left near the vitreous base under silicone oil (inset).

those with the higher-affinity anti-VEGF agents. Pegaptanib achieves regression of neovascularization and reduces the risk of intraoperative bleeding without a significant crunch effect. This is probably due to its inhibition of only VEGF isoform 165.¹⁹

Intravitreal Steroids

In our hands, preoperative administration of the dexamethasone intravitreal implant 0.7 mg (Ozurdex, Allergan) has facilitated regression and consolidation of neovascularization in patients with high-risk PDR and extensive FVP, without the crunch phenomenon or increased adherence of FVP to the retina that is seen in response to anti-VEGF therapy.¹³ We insert the implant in the inferior vitreous base, away from any dissection, and we leave it embedded in the vitreous during the vitrectomy so that it does not become mobilized by intraoperative currents in the vitreous cavity.

Because this implant inhibits multiple inflammatory cytokines and releases the active drug over a period of 3 to 5 months, it permits flexible planning and keeps inflammation and rebound neovascularization at bay throughout the postoperative period.¹³ In our experience, the efficacy of the implant is not diminished by the use of silicone oil tamponade after surgery, and we have not seen any complications using it with silicone oil (Figure 2).¹³

Tools

Valved Cannulas

During vitrectomy, the use of valved cannulas supports stable intraoperative fluidics and enhances surgeon control of intraocular pressure (IOP). The ability to temporarily elevate IOP during vitrectomy enables the surgeon to control

hemostasis, often without the need for diathermy. Use of an IOP-compensated infusion setting is also advised for adaptive IOP control during surgery.

Scleral Buckle

Placement of a scleral buckle should be considered as an adjunct to vitrectomy in eyes with severe anteroposterior traction (eg, peripheral TRD with a rhegmatogenous component), especially in phakic patients in whom adequate peripheral dissection may not easily be achieved.

Intraoperative OCT

Intraoperative OCT provides the surgeon with anatomic feedback that may help to guide and enhance surgical decision-making. We have found intraoperative OCT to be helpful in selected complex PDR cases for identifying tissue dissection planes, visualizing the retinal architecture beneath FVP, and diagnosing inadvertent macular hole formation.

Techniques

Dissection

Some surgeons have advocated pushing techniques (eg, proportional reflux and viscodissection) for PDR surgery. We prefer using traditional unimanual or bimanual dissection techniques for segmentation and delamination to avoid retinal breaks associated with pushing techniques. Bimanual dissection techniques using different combinations of instruments (eg, vertical and curved scissors, vitreous cutter, forceps, and picks) are particularly effective with tightly adherent FVP membranes and can be quite efficient if properly selected. Bimanual techniques require the use of chandelier lighting systems or illuminated instruments such as the lighted pick.²⁰

Mixed-Gauge Vitrectomy

Over the past several years, small-gauge vitrectomy equipment has improved so much that it is now our preferred instrumentation for PDR surgery. Narrow-profile vitreous cutters (eg, 27-gauge) are advantageous in their ability to navigate the narrow dissection planes often encountered in TRD surgery (Figure 3A). Compared with 23- and 25-gauge systems, 27-gauge instruments lack the stiffness needed to reach peripheral pathology. However, when passed through a 23-gauge cannula, a 27-gauge cutter can access more of the periphery due to increased freedom of rotation within the larger-diameter cannula (Figure 3B).²¹

We have adopted a mixed 27- and 23-gauge platform for many of our diabetic TRD cases. This combination allows us to leverage the advantages of the 27-gauge cutter when dissecting posterior and peripheral FVP and still have access to the full range of ancillary instrumentation available in 23 and 25 gauge.²¹

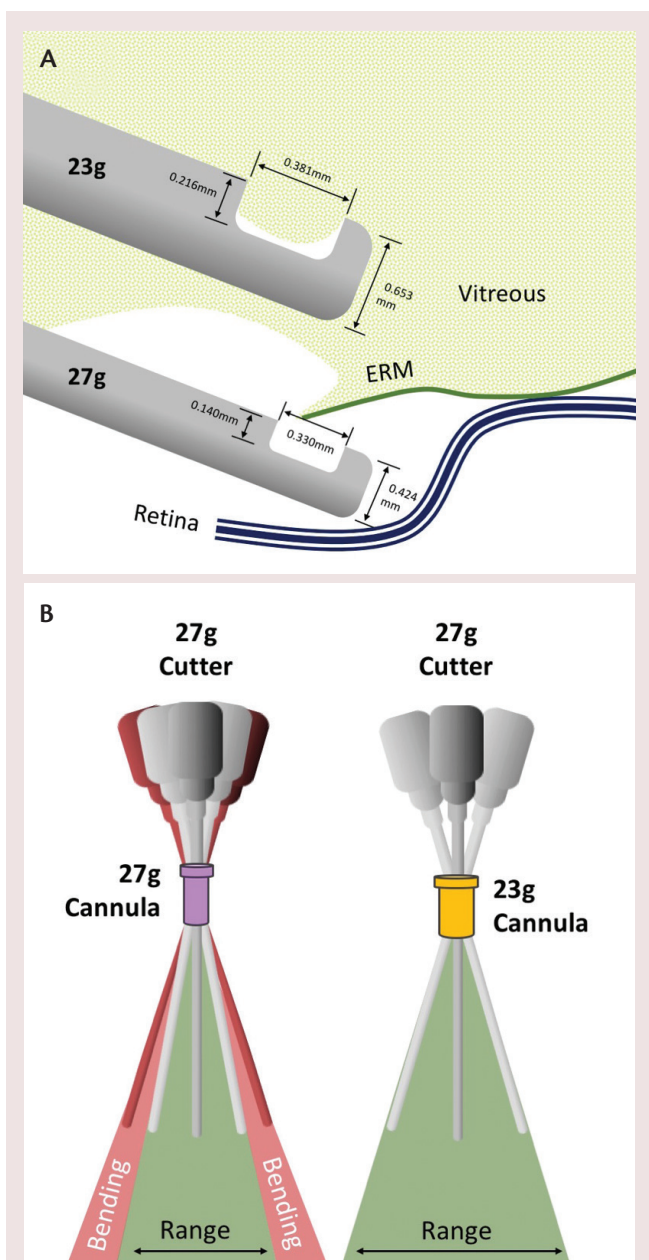


Figure 3. Mixed 27- and 23-gauge vitrectomy. Geometry of the 27-gauge probe is favorable for dissection of tightly adherent membranes (A). Passage of a 27-gauge probe through a 23-gauge cannula increases the range of motion within the eye without bending of the instrument shaft (B). Figure 3A adapted with the authors' permission from Walter SD, Mahmoud TH.²¹

CONCLUSION

Despite medical advances in the management of patients with diabetes, surgical intervention remains essential for visual rehabilitation of selected patients with nonclearing

VH and tractional complications of PDR. Knowing which of these patients to operate on, how to prepare them for surgery, and how to manage their expectations after surgery will never be an exact science and therefore requires careful consideration. For patients whom we treat surgically, new tools and refined techniques, including preoperative pharmacotherapy, intraoperative OCT, and mixed-gauge vitrectomy, enhance our ability to manage their disease. ■

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