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Review Article

A Comprehensive Guide for Pars Plana Vitrectomy in Diabetic Tractional Retinal Detachment

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Abstract

Pars plana vitrectomy (PPV) for tractional retinal detachment (TRD) is a challenging surgical procedure, especially for beginners. This article outlines key tips and techniques to improve surgical outcomes, minimize complications, and enhance safety during a diabetic TRD surgery. A stepwise approach, instrument selection, and specific manoeuvres to address fibrovascular proliferation, iatrogenic breaks, and haemostasis are discussed.

Keywords: Pars Plana Vitrectomy (PPV); Tractional Retinal Detachment (TRD); Retinal Pigment Epithelium (RPE)

Introduction

Tractional retinal detachment (TRD) poses a significant threat to vision and can be particularly difficult for inexperienced surgeons to handle. This condition arises when fibrovascular tissue growth pulls the retina away from the retinal pigment epithelium (RPE). The primary treatment for TRD is pars plana vitrectomy (PPV), a procedure that demands both precision and expertise. During PPV, the vitreous body is removed to alleviate the traction on the retina, facilitating its reattachment. However, achieving successful results largely depends on the surgeon's technique and the careful management of complications during and after the surgery. This article provides crucial advice and strategies for novice surgeons undertaking PPV in cases of tractional retinal detachment.

Pre-operative considerations

- **Fundus examination**: Perform a detailed dilated fundus examination to evaluate the extent of the detachment, fibrovascular proliferation, traction points, and associated vascular abnormalities.
- **Spectral-domain optical coherence tomography (OCT)** imaging is helpful in assessing the level and severity of the membranes and can provide clues regarding the location of potential spaces where safe dissection or initiation of membrane removal can be performed.
- **Systemic evaluation:** Ensure proper control of underlying conditions (e.g., diabetes, hypertension) pre-operatively, as these can affect surgical outcomes.
- **Anaesthesia Choice**: General anaesthesia is preferable for uncooperative patients, while local anaesthesia with sedation can be used in selected cases.
- **Preoperative Pan-retinal photocoagulation**: Preoperative pan-retinal photocoagulation (PRP) may be considered in cases of TRD, particularly when the eye has not previously undergone laser treatment or when prior laser interventions appear insufficient. While PRP can contribute to stabilizing the eye in instances of proliferative diabetic retinopathy (PDR) with TRD, there exists a potential risk of inducing retinal tears, especially if excessive laser power is applied.

This risk is associated with the laser energy and the consequent fibrovascular contraction. However, performing PRP at a safe distance from the base of the fibrous membranes preoperatively can facilitate the induction of posterior vitreous detachment (PVD) and enhance surgical ease. Additionally, it may reduce the duration required to complete endolaser pan-retinal photocoagulation and it also causes less post-operative inflammation [1].

- **Preoperative Anti-VEGF Therapy**: Administering intravitreal anti-VEGF agents 3 to 7 days prior to surgery can mitigate intraoperative bleeding and aid in membrane dissection [2].
- **Surgical planning:** It is essential to determine in advance whether combined procedures, such as cataract extraction, are necessary. If deemed necessary, cataract surgery in conjunction with an anti-VEGF injection should be scheduled 3-7 days prior to the vitrectomy. Sutures should be placed at the main tunnel to prevent the anterior chamber from collapsing during the insertion of sclerotomy ports.
- Patients are typically prescribed anticoagulants to manage their systemic comorbidities. It is recommended that these anticoagulants be discontinued at least five days prior [3].
- Ensuring strict control of glycemic levels and hypertension in patients scheduled for surgery is crucial to reducing the risk of postoperative infections and intraoperative inadvertent bleeding. Frequently, surgical procedures are postponed due to elevated blood glucose levels or uncontrolled hypertension.

Pars Plana Vitrectomy

- **Sclerotomy ports:** Following conjunctival displacement, a biplanar sclerotomy incision is favored over a stab incision, as it minimizes the risk of wound leakage, hypotony, and gas leakage. Additionally, it facilitates the self-sealing of ports in the event that sutureless surgery is planned [4].
- **Bimanual approach**: A bimanual, four port sclerotomy PPV is preferred particularly in TRD for easy and fast removal of traction and membranes. In a bimanual technique, both hands are actively used for dissection under visualization provided by a self-retaining illuminating system (i.e., a chandelier lighting system) [5].
- The selection of an appropriate gauge is crucial, with a 25-gauge being the preferred choice for addressing tractional retinal detachment.

Vitrectomy

- Port site vitrectomy should be done prior to entering instruments to reduce the chances of vitreous dragging by the instruments followed by a core vitrectomy.
- **Truncation:** Following a thorough core vitrectomy, truncation should be conducted to detach the central posterior hyaloid from the periphery, thereby alleviating anteroposterior traction.
- Inducing posterior vitreous detachment (PVD) in cases of diabetic tractional retinal detachment (TRD) presents significant challenges due to the dense adhesion of the posterior hyaloid to the retina. Extreme caution is required during this procedure, as it may result in substantial retinal breaks.
- **Membrane peeling:** Utilize indirect lighting to accentuate fibrous membranes, and carefully elevate the edges of these membranes using retinal forceps. It is advisable to employ a low-cut vitreous cutter to dissect the membranes in stratified layers.
- **Micro-forceps and end-grasping techniques:** Utilize microforceps and end-grasping techniques with precision to prevent additional retinal damage when handling the membranes. In instances where membrane removal proves challenging, employ supplementary instruments such as intraocular scissors to facilitate the process.

Membrane dissection

- Careful dissection is crucial to avoid causing new retinal breaks or hemorrhages.
- **Identifying the Plane:** Accurately identifying the plane where the membrane is attached to the retina is essential.
- **"Inside-out" or "Outside-in" Approach:** Following the release of the peripheral vitreous, focus is directed towards the posterior pole. The fibrous tractional membranes can be addressed using either an outside-in or an inside-out approach. The outside-in method involves initiating membrane dissection at the arcades and progressing towards the optic nerve. Conversely, the inside-out technique begins dissection at the optic nerve and extends towards the periphery. We advocate for the inside-out approach, as the retina exhibits greater structural integrity near the nerve, and the junction between the nerve and the retina offers substantial counter traction during dissection [6].

- **Segmentation and Delamination:** Segmentation and delamination represent the primary surgical methodologies employed in the excision of membranes. Segmentation involves the division of fibrotic epiretinal membranes into smaller segments or islands, while delamination entails the removal of these segments from the retinal surface. Segmentation can be executed using either a cutter or scissors. Recent advancements in small-gauge cutters, such as the positioning of the port closer to the tip and enhanced fluidics, have enabled surgeons to utilize these instruments as vertical scissors. To commence the segmentation process, a blunt-tipped pick or the cutter tip is meticulously maneuvered between the membrane and the retina, creating space by moving the instrument laterally to sever adhesions. Due to the elastic nature of these membranes, they typically scroll slightly once the adhesions are severed. Subsequently, the cutter port can be inserted into the space between the membrane and retina to cut or segment the membrane [6].
- En-bloc dissection is a technique wherein the entire fibrovascular proliferation and the posterior hyaloid are detached from the optic nerve head in a single, cohesive piece. The use of a cutter to sever the attachment near the disc to induce posterior vitreous detachment (PVD) is often associated with significant hemorrhage and/or multiple retinal breaks, leading most retinal surgeons to avoid this approach [6].
- **Hemostasis:** Bleeding should be addressed promptly and thoroughly. Hemostasis can be achieved through temporary elevation of intraocular pressure (IOP), mechanical compression of the bleeding site using a cutter tip or a soft-tipped cannula, endodiathermy, green light endophotocoagulation, or a combination of these methods. Once all tangential tractional forces are released, residual bleeding should be meticulously assessed by gradually lowering the IOP to 15 mmHg, which simultaneously allows for the examination of potential sites of immediate postoperative bleeding [6].
- **Sub-retinal fluid (SRF) drainage**: In cases of TRD, although SRF drainage may not be essential, it can facilitate earlier macular reattachment for TRD that extends beyond the arcades and aid in retinal reattachment [7,8].
- Laser photocoagulation around retinal breaks and PRP (or supplementary PRP) up to the ora serrata is then performed. Endo-photocoagulation probe with curved tip is preferred, especially in phakic patients. Laser marks should be as light as possible and spaced one laser mark apart. Care should be taken to avoid the 3- and 9-o'clock hours to prevent damage to the ciliary nerves and avoid postoperative loss of accommodation.
- **Tamponade**: In relatively straightforward cases and those not involving retinotomy, management is typically achieved using either filtered air or gases such as SF6 or C3F8. Conversely, silicone oil is the preferred tamponade in complex cases and those requiring extended tamponade duration. Silicone oil serve as a protective barrier against neovascular growth factors and cytokines that may impact ocular tissues. These oils are generally removed after 3 to 6 months or upon the emergence of silicone oil-related complications. In instances of pure tractional retinal detachment (TRD), the primary objective of the surgical procedure is the safe excision of all reactive tissues. Once this is accomplished, the surgery is concluded. Although subretinal fluid (SRF) may persist at the conclusion of the surgery, it typically resolves over time due to the retinal pigment epithelium's (RPE) pump function. However, in certain cases where SRF is thick due to chronic TRD, resolution may exceed six months [9,10].
- After appropriate tamponade, sclerotomy sites are checked at the end of surgery and sutured if wound leakage is noted. An intravitreal anti-VEGF agent may be injected after surgery to prevent recurrent hemorrhage.
- It is advisable to coordinate the removal of silicone oil with cataract surgery if significant cataract formation occurs following vitrectomy. Long-term retention of silicone oil should be avoided due to the increased risk of epiretinal membrane (ERM) formation and ocular hypertension. Silicone oil should not remain in the eye for more than six months post-injection, with the optimal removal period being between two to three months [11].

Postoperative care and follow-up

Ensure comprehensive postoperative care, which includes appropriate patient positioning, when necessary, in cases of combined retinal detachment, administration of prescribed medica-

tions, and regular follow-up appointments. Educate the patient on the importance of maintaining strict glycemic control. Conduct regular monitoring for any indications of infection, elevated intraocular pressure, or recurrent retinal detachment.

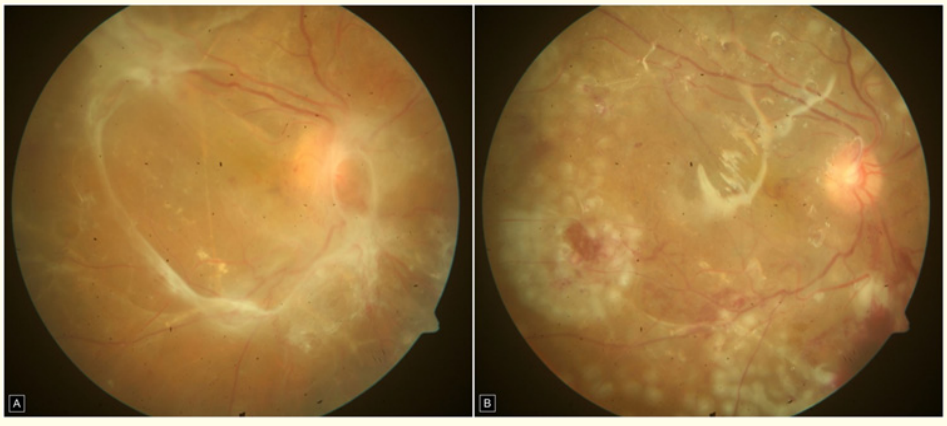

Figure 1: A and B shows pre-operative and post-operative images of a diabetic TRD case. Image B shows release of pre-existing retinal traction with PRP endolaser and laser around retinal break with silicone oil tamponade.

Complications

The complications of Retinal traction detachment include progressive retinal ischemia and atrophy of the photoreceptor layer. Progressive retinal ischemia may result in neovascularisation of iris (NVI), neovascularisation of angle (NVA), and neovascular glaucoma (NVG). Complications of the vitrectomy for RTD include disperse vitreous hemorrhage, secondary ocular hypertension, recurrent retinal detachment, cataract formation, and NVG [6].

Prognosis

The surgical variables that may influence postoperative outcomes include the choice of instrumentation gauge, duration of surgery, techniques employed for membranectomy, selection of tamponade agent, and the surgeon's level of expertise. Several studies have indicated that the use of silicone oil as a tamponade agent in diabetic vitrectomy is associated with less favorable outcomes. This adverse outcome may be attributed to the necessity of silicone oil in complex TRD cases, which often present with more extensive preoperative structural damage to the retinal tissue. The long-term success rates in eyes with TRD undergoing vitrectomy have shown considerable variability, largely contingent upon the management of systemic factors, such as diabetes mellitus [6].

Conclusion

As diabetes continues to exert a significant impact on global public health, diabetic retinopathy is anticipated to affect an increasing number of individuals, despite a decline in its incidence. With the advent of advanced microincision instruments and sophisticated imaging systems, vitreoretinal specialists are now able to perform more intricate maneuvers in PPV for a broader range of PDR cases. Enhancing our understanding of PDR, particularly in managing complications such as diabetic maculopathy, cataract-associated conditions, central retinal artery occlusion (CRAO), and neovascular glaucoma (NVG), facilitates the timely intervention by surgeons to perform vitrectomy, thereby improving both anatomical and functional outcomes for long-term stabilization. Based on the findings and new perspectives discussed in the present article, we posit that PPV will benefit a greater number of PDR patients.

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