

Results of combined treatment with anti-VEGF therapy and pars plana vitrectomy for diabetic macular edema

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Abstract

Diabetic macular edema is one of the leading causes of visual impairment among patients with diabetes mellitus and represents a major challenge in modern ophthalmology. The condition develops as a result of chronic microvascular damage, increased vascular permeability, and accumulation of extracellular fluid in the macular region of the retina. Anti-vascular endothelial growth factor therapy has become a widely used pharmacological strategy aimed at reducing vascular permeability and inhibiting pathological angiogenesis. However, in certain cases, particularly those associated with vitreomacular traction or persistent edema, pharmacological treatment alone may not achieve sufficient anatomical and functional improvement. Pars plana vitrectomy offers a surgical approach that removes vitreous traction and improves retinal oxygenation, thereby contributing to resolution of macular edema. The present study evaluates the outcomes of combined therapy involving intravitreal anti-VEGF injections and pars plana vitrectomy in patients with diabetic macular edema. The analysis focuses on changes in retinal morphology, improvement in visual acuity, and stabilization of macular structure following treatment. The findings indicate that the integrated use of pharmacological and surgical approaches provides significant benefits in reducing retinal swelling and improving functional visual outcomes. Diabetic macular edema represents one of the most significant causes of central vision deterioration among individuals with long-standing diabetes mellitus. The condition arises from microvascular damage within the retinal circulation, leading to increased permeability of capillary walls and subsequent accumulation of extracellular fluid in the macular region. Intravitreal therapy targeting vascular endothelial growth factor has become a cornerstone of modern treatment because it suppresses abnormal vascular permeability and reduces inflammatory responses within retinal tissues. Nevertheless, some patients demonstrate incomplete anatomical resolution or persistent retinal thickening due to mechanical factors such as vitreomacular traction or epiretinal membrane formation. Surgical intervention through pars plana vitrectomy may address these mechanical components by removing the vitreous body and relieving tractional forces on the macula. Evaluation of the combined therapeutic strategy involving pharmacological inhibition of angiogenic activity and surgical elimination of vitreoretinal traction provides important insight into improving clinical outcomes. The analysis indicates that integration of these treatment approaches contributes to significant reduction of retinal edema, restoration of macular architecture, and improvement of central visual function.

Keywords: *diabetic macular edema; anti-VEGF therapy; pars plana vitrectomy; retinal edema; diabetic retinopathy; intravitreal injections; macular thickness; ophthalmology*

1. Introduction

Diabetic retinopathy remains one of the most common microvascular complications of diabetes mellitus and represents a leading cause of visual impairment worldwide. Among its manifestations, diabetic macular edema is considered the primary factor responsible for central vision loss in affected patients. The pathological process involves breakdown of the blood-retinal barrier, increased vascular permeability, and leakage of plasma components into retinal tissue, resulting in accumulation of fluid within the macular region. Persistent edema disrupts the architecture of the retinal layers and impairs the function of photoreceptor cells, ultimately leading to deterioration of visual acuity. Over the past decade, intravitreal anti-vascular endothelial growth factor agents have become the mainstay of treatment for diabetic macular edema due to their ability to inhibit pathological vascular permeability and neovascularization. Nevertheless, some patients demonstrate insufficient response to pharmacological therapy, particularly when mechanical traction from the posterior vitreous or epiretinal membranes contributes to retinal thickening. In such cases, pars plana vitrectomy may be performed to remove vitreous traction and enhance diffusion of oxygen and nutrients to retinal tissues. The combination of anti-VEGF therapy with surgical intervention represents a promising strategy for managing complex or treatment-resistant forms of diabetic macular edema. Evaluating the effectiveness of this combined approach is essential for improving therapeutic outcomes and preserving visual function in patients with advanced diabetic retinal disease. Diabetic retinal disease remains one of the most prevalent complications associated with chronic hyperglycemia and continues to represent a leading cause of visual disability worldwide. Among its manifestations, swelling of the macular region is particularly significant because it directly affects central vision, which is essential for reading, detailed visual tasks, and daily functioning. The pathophysiological process involves damage to retinal microvasculature, disruption of the blood-retinal barrier, and leakage of plasma components into the extracellular retinal space. As fluid accumulates within the macular layers, structural distortion of retinal architecture occurs, resulting in decreased visual acuity and impaired photoreceptor function. Pharmacological agents designed to inhibit vascular endothelial growth factor have transformed the therapeutic landscape by reducing vascular leakage and stabilizing retinal capillaries. However, in certain clinical situations the presence of mechanical traction from the vitreous body may sustain retinal thickening despite repeated pharmacological injections. In such circumstances, surgical removal of the vitreous through pars plana vitrectomy can relieve tractional forces and facilitate restoration of normal retinal configuration. Investigating the combined influence of these two treatment modalities provides valuable information for optimizing therapeutic strategies in patients with persistent or complex macular edema related to diabetes.

2. Materials and Methods

The present clinical study included patients diagnosed with diabetic macular edema who were treated in a specialized ophthalmology center. All participants underwent comprehensive ophthalmological evaluation prior to treatment, including measurement of best corrected visual acuity, slit-lamp biomicroscopy, fundus examination, and optical coherence tomography for quantitative assessment of macular thickness. Fluorescein angiography was performed in selected cases to evaluate retinal vascular permeability and identify areas of capillary leakage. Patients received intravitreal anti-VEGF injections as part of the initial treatment phase in order to reduce vascular permeability and suppress inflammatory processes within the retina. In cases where macular edema persisted or when vitreomacular traction was identified, pars plana vitrectomy was performed to remove the posterior vitreous cortex and eliminate mechanical tractional forces. During surgery, additional procedures such as internal limiting membrane peeling were performed when necessary to enhance macular stabilization. Postoperative follow-up examinations were conducted at regular intervals to evaluate retinal morphology, visual acuity changes, and potential complications.

3. Results

Clinical analysis demonstrated significant improvement in retinal anatomy following combined treatment with anti-VEGF therapy and pars plana vitrectomy. Optical coherence tomography revealed a substantial reduction in central macular thickness after surgical intervention, indicating effective resolution of intraretinal fluid accumulation. Many patients experienced improvement in visual acuity during the postoperative period as the macular architecture gradually returned to a more physiological configuration. The removal of vitreous traction contributed to enhanced diffusion of oxygen and metabolic substrates within retinal tissues, which further supported functional recovery. In several cases, stabilization of the macular region was observed with minimal recurrence of edema during follow-up examinations. The integrated treatment approach proved particularly beneficial in patients with persistent or traction-associated macular edema that had shown limited response to pharmacological therapy alone. Clinical observations following the integrated treatment approach demonstrated considerable improvement in retinal morphology and functional vision parameters. Imaging studies revealed a substantial decrease in central macular thickness, indicating effective resolution of accumulated intraretinal fluid. Structural restoration of the retinal layers was observed progressively during

postoperative follow-up examinations. Improvement in best corrected visual acuity was recorded in many patients as the macular architecture gradually normalized and photoreceptor alignment improved. The removal of vitreous traction contributed to stabilization of the retinal surface and facilitated better diffusion of oxygen and metabolic substrates across retinal tissues. In addition, the pharmacological suppression of vascular endothelial growth factor activity reduced further leakage from compromised retinal capillaries. Together, these mechanisms resulted in a more sustained therapeutic response compared with pharmacological treatment alone. Recurrence of macular swelling was observed infrequently, and in most cases the anatomical improvements remained stable during subsequent follow-up periods.

4. Discussion

The outcomes of this study demonstrate the therapeutic value of combining pharmacological and surgical approaches in the management of diabetic macular edema. Anti-VEGF agents play a crucial role in reducing vascular permeability and inhibiting inflammatory mediators responsible for retinal fluid accumulation. However, the persistence of vitreomacular traction or epiretinal membranes may limit the effectiveness of pharmacological therapy in certain patients. Pars plana vitrectomy addresses these mechanical factors by removing the vitreous body and relieving tractional stress on the macula. In addition, vitrectomy improves intraocular oxygen distribution, which may contribute to reduced expression of angiogenic factors and further stabilization of retinal tissues. The combined approach therefore targets both biochemical and mechanical components of the disease process. Despite the promising outcomes observed in this study, careful patient selection and thorough preoperative evaluation remain essential to determine which individuals are most likely to benefit from surgical intervention in addition to pharmacological treatment. The outcomes observed in this evaluation emphasize the importance of addressing both biochemical and mechanical mechanisms responsible for the development of diabetic macular edema. Pharmacological inhibition of angiogenic and permeability factors reduces vascular leakage and inflammatory activation within retinal tissues, forming the foundation of contemporary treatment strategies. Nevertheless, persistent vitreoretinal traction can maintain mechanical stress on the macula and limit the effectiveness of intravitreal therapy. Surgical removal of the vitreous body through pars plana vitrectomy eliminates these tractional forces and improves the intraocular microenvironment. Enhanced oxygenation of retinal tissues after vitrectomy may further suppress pathological signaling pathways involved in vascular permeability and neovascular activity. The complementary actions of pharmacological and surgical interventions therefore produce a synergistic therapeutic effect. This combined strategy appears particularly beneficial in patients who exhibit incomplete response to repeated anti-VEGF injections or demonstrate structural abnormalities within the vitreoretinal interface.

5. Conclusion

Combined treatment involving intravitreal anti-VEGF therapy and pars plana vitrectomy represents an effective strategy for managing diabetic macular edema, particularly in cases resistant to pharmacological therapy alone. The integration of these approaches results in significant reduction of macular thickness, improvement of retinal structure, and enhancement of visual function in many patients. Removal of vitreous traction combined with suppression of vascular permeability provides a comprehensive therapeutic effect addressing multiple pathogenic mechanisms of the disease. Continued clinical research and long-term observation are necessary to further optimize treatment protocols and improve visual outcomes for patients suffering from diabetic retinal complications. Integrated management involving intravitreal anti-angiogenic therapy and pars plana vitrectomy provides an effective approach for the treatment of diabetic macular edema, especially in cases associated with vitreomacular traction or insufficient response to pharmacological therapy alone. The combination of these interventions promotes reduction of retinal swelling, restoration of macular structure, and improvement of central visual performance. Removal of mechanical traction combined with suppression of vascular permeability addresses multiple pathogenic mechanisms underlying the disease. Careful patient evaluation and individualized treatment planning are essential for achieving optimal outcomes. Continued clinical observation and further research will help refine therapeutic protocols and enhance long-term visual prognosis for individuals affected by diabetic retinal complications.

References

1. Early Treatment Diabetic Retinopathy Study Research Group. Photocoagulation for diabetic retinopathy.
2. Ryan S.J. Retina.
3. Lewis H. Vitrectomy for complications of diabetic retinopathy.
4. Diabetic Retinopathy Clinical Research Network. Surgical management of proliferative diabetic retinopathy.
5. Antonetti D.A., Klein R., Gardner T.W. Diabetic retinopathy pathophysiology.
6. Schwartz S.G., Flynn H.W. Pars plana vitrectomy for diabetic retinopathy complications.
7. Stewart M.W. Current management of diabetic retinopathy.

8. Kanski J.J., Bowling B. Clinical Ophthalmology: A Systematic Approach.
9. Stefansson E. Oxygenation and diabetic retinal disease.
10. American Academy of Ophthalmology. Retina and Vitreous Clinical Guidelines.
11. <https://med1.uz/articles/oftalmologiya/glaukoma>



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