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Choroidal Vascular Changes in Eyes with Pseudoexfoliative Glaucoma and their Fellow Eyes

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Abstract

Pseudoexfoliative glaucoma (PEXG) is a prevalent form of secondary open-angle glaucoma characterized by the deposition of abnormal extracellular material on ocular tissues, particularly the anterior segment. Although its effects on intraocular pressure and trabecular meshwork have been well-documented, the impact of PEXG on the choroidal vascular system remains less explored. This article aims to review and analyze existing literature on choroidal vascular changes in eyes affected by PEXG and their fellow eyes without the disease. Understanding these vascular changes may shed light on the underlying pathophysiology and provide insights into potential diagnostic and therapeutic strategies.

Keywords: Glaucoma; Choroidal vascular; Pseudoexfoliative glaucoma

Introduction

Glaucoma is a progressive optic neuropathy that leads to irreversible vision loss and is a significant cause of blindness worldwide. Pseudoexfoliative glaucoma is a distinct subset of glaucoma, characterized by the accumulation of abnormal fibrillary material, known as pseudoexfoliation material, in various ocular tissues, including the anterior chamber angle and lens capsule [1]. While the primary pathogenesis involves the anterior segment, recent studies have suggested that PEXG might also have implications for the posterior segment, specifically the choroidal vasculature. The choroid plays a critical role in ocular blood supply, nourishing the outer retina and maintaining retinal homeostasis. Any alteration in its vascular structure and function could have potential implications for glaucoma progression and visual impairment.

Enhanced-depth imaging-optical coherence tomography can provide important information on the velocity of choroidal blood flow. With the application of EDI-OCT, it is possible to capture an image of the full thickness of the choroid in vivo. Previous studies of the choroidal thickness of PXG eyes have reported controversial results. One study found that the peripapillary and macular choroidal thickness of PXG eyes measured with spectral-domain optical coherence tomography (SD-OCT) was decreased compared to that of normal eyes. Another study reported that the peripapillary and macular choroidal thickness measured with SD-OCT in PXG eyes did not differ significantly from that of normal eyes [2]. No studies have compared the peripapillary and macular choroidal thickness and volume of PXG eyes, nonexfoliative fellow eyes, and normal eyes. In addition, whether exfoliating material can cause abnormal ocular blood flow is still not clear. Measurement of choroidal thickness through enhanced-depth imaging-optical coherence tomography can provide important information on the velocity of choroidal blood flow. In this study, using EDI-OCT, we measured the peripapillary and macular choroidal thickness and volume of PXG eyes, nonexfoliative fellow eyes, and normal eyes among the Chinese population and analyzed changes in choroidal thickness. We aimed to determine the effect of the choroid on PXG development and progression.

Choroidal vascular changes in PEXG

Several studies utilizing advanced imaging techniques, such as optical coherence tomography (OCT) and indocyanine green angiography (ICGA), have sought to investigate choroidal vascular changes in eyes with PEXG. These investigations have revealed noteworthy findings:

Choroidal thinning: A common observation in eyes with PEXG is choroidal thinning, especially in the macular region. Reduced choroidal thickness has been associated with disease severity and may be a potential marker for monitoring disease progression [3].

Vascular density alterations: Studies employing OCT angiography have shown alterations in the choroidal vascular density in PEXG eyes. The changes in vessel density may indicate impaired perfusion and blood flow regulation in the choroidal vasculature.

Choroidal ischemia: Choroidal hypoperfusion and ischemia have been reported in PEXG eyes, suggesting compromised blood supply to the outer retinal layers. This could contribute to retinal ganglion cell dysfunction and eventual visual field loss [4].

Choroidal neovascularization (CNV): Some reports have indicated an increased incidence of CNV development in PEXG eyes, possibly due to the vascular changes and compromised blood flow in the choroid [5].

Potential mechanisms and Implications

The mechanisms underlying choroidal vascular changes in PEXG are not yet fully understood. However, it is speculated that the accumulation of pseudoexfoliative material within the trabecular meshwork and the ciliary body might disturb the autoregulatory mechanisms of choroidal blood flow, leading to vascular alterations. Additionally, oxidative stress and inflammation associated with pseudoexfoliative material deposition could contribute to choroidal vascular dysfunction [6].

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Understanding the choroidal vascular changes in PEXG has several potential implications

Early Diagnosis and Progression Monitoring: Monitoring choroidal thickness and vascular density may serve as non-invasive tools for early detection and monitoring of disease progression in PEXG [7].

Therapeutic targets: Choroidal changes could present novel therapeutic targets for managing PEXG. Strategies aimed at improving choroidal perfusion and reducing ischemia may be explored to preserve retinal function [8].

Risk assessment: Identifying eyes at higher risk of developing CNV based on choroidal vascular changes may facilitate targeted interventions to prevent vision-threatening complications.

Discussion

The pathogenesis of glaucoma is not yet clear. Hemodynamic abnormalities in the optic disc, retina, and choroid may play an important role in the etiology of glaucoma. Galassi et al. found that PXG eyes were more prone to reduced perfusion pressure and abnormal retrobulbar vascular hemodynamics than normal eyes and believed that damaged vascular regulation or deposition of pseudoexfoliative materials in ocular blood vessels was involved in PXG development [9]. Previous studies confirmed that open angle glaucoma is not associated with significant thinning or thickening of the choroid based on EDI-OCT measurements. Koz et al. found that a significant proportion of PEX patients with normal IOP also had glaucomatous changes and speculated that the optic disc damage in PXG eyes might not be related to IOP. The large range of IOP fluctuations in PXG eyes may be an important factor underlying glaucoma progression, but the impact of pseudoexfoliation and choroidal dysfunction on glaucoma progression cannot be ruled out. The pathogenesis of glaucoma is closely related to retrobulbar blood flow. The choroidal blood supply around the optic papilla derives from the posterior ciliary artery and the Zinn-Haller arterial ring in the sclera, providing blood for the cribriform plate at the optic nerve head. Abnormal choroidal blood supply can cause glaucomatous optic neuropathy, and blood flow resistance is related to the diameter of blood vessels [10].

Conclusion

Choroidal vascular changes in PEXG represent an intriguing area of research that requires further exploration. The understanding of these alterations and their implications could aid in better managing the disease and improving visual outcomes. Advanced imaging modalities and longitudinal studies are necessary to elucidate the precise mechanisms and establish the clinical significance of choroidal vascular changes in eyes with PEXG and their fellow eyes.

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