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Assessment of Retinal Blood Flow in Individuals with Monoclonal Gammopathy Utilizing OCT Angiography

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Abstract

Monoclonal Gammopathy (MG) is characterized by the excessive production of monoclonal proteins, potentially leading to the onset of hyperviscosity syndrome. This study aims to evaluate retinal circulation utilizing optical coherence tomography angiography parameters in individuals with monoclonal gammopathy. The study involved OCTA measurements using the Optovue AngioVue system, analyzing 44 eyes of 27 MG patients and 62 eyes of 36 control subjects. Parameters such as superficial and deep retinal capillary vessel density (VD SVP and DVP) across the entire 3 × 3 mm macular and parafoveal region, foveal avascular zone (FAZ) area, and central retinal thickness (CRT) were quantified using AngioAnalytics software. Employing a multivariate regression model, the OCTA parameters were compared between the two groups, with adjustments for imaging quality (SQ). Age showed no significant difference between monoclonal gammopathy subjects and controls (63.59 ± 9.33 *vs.* 58.01 ± 11.46 years; $p>0.05$). After accounting for image quality, VD SVP was notably lower in the MG group than the control group (44.54 ± 3.22% *vs.* 46.62 ± 2.84%; $p<0.05$). No significant disparities were observed in the other OCTA parameters between the groups ($p>0.05$). The reduced superficial retinal capillary vessel density, as indicated by OCTA, in MG patients implies sluggish blood flow, diminished capillary circulation, and subsequent tissue hypoperfusion. This investigation proposes that OCTA assessment of retinal circulation in cases of monoclonal gammopathy could serve as a sensitive non-invasive method for detecting and monitoring early microcirculatory dysfunction resulting from heightened viscosity.

Keywords: Monoclonal gammopathy • Multiple myeloma • Hyperviscosity syndrome

Introduction

Monoclonal gammopathies manifest through the clonal proliferation of plasma cells, leading to serum M-protein presence, often termed paraproteinemia. The prevalent variant, monoclonal gammopathy of undetermined significance (MGUS), affects 3% of individuals aged 50 or above and 5% of those aged 70 or older. According to the International Myeloma Working Group, MGUS is characterized by serum M-protein below 3 g/dL, monoclonal plasma cells below 10% in bone marrow, and the absence of organ damage linked to plasma cell disorders, like bone lesions, anemia, hypercalcemia, and renal insufficiency. The M-protein types include IgG (69%), IgM (17%), IgA (11%), and biclonal (3%). While IgG and IgA MGUS patients often progress to multiple myeloma (MM), IgM monoclonal overproduction may lead to Non-Hodgkin's lymphoma, Waldenström's macroglobulinemia, chronic lymphocytic leukemia, and AL amyloidosis. MGUS is seen as a premalignant state, with IgG MGUS carrying a 1% annual risk of MM progression and IgM MGUS having a 1.5% risk of WM progression. Cumulative risks at 10, 20, and 40 years are 10%, 18%, and 36%, respectively. Recent connections between MGUS and conditions such as renal disease, polyneuropathy, and ocular conditions suggest M-protein's role in organ dysfunction development [1-3].

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Description

Ocular signs of monoclonal gammopathy, albeit uncommon, predominantly impact the anterior segment. Ocular issues arise from monoclonal kappa light chain immunoglobulin deposition in ocular tissues or hyperviscosity syndrome due to elevated circulating serum immunoglobulins. Literature notes proptosis, deposits on conjunctiva and cornea, copper deposition in Descemet's membrane, maculopathy with serous detachment, autoimmune retinopathy, central retinal vein occlusion, and hyperviscosity-related retinopathy. Crystalline keratopathy, characterized by corneal immunoglobulin light chain deposits, is seen in less than 1% of patients. Retinal vascular symptoms encompass venous dilation, hemorrhages, cotton wool spots, and microaneurysms, attributed to hyperviscosity, commonly seen in Waldenström's macroglobulinemia. Ocular symptoms might herald monoclonal gammopathy, thus early detection aids in monitoring progression to myeloma or WM [4].

Optical coherence tomography angiography emerges as a non-invasive, valuable ophthalmic imaging method, revealing retinal and choroidal vascular layers. It uses motion contrast to visualize blood flow sans dye injection. OCTA assists in diabetic retinopathy, age-related macular degeneration, retinal artery/vein occlusions, and glaucoma assessment. Additionally, it offers data on retinal blood flow, making it suitable for objective disease monitoring.

As posterior segment involvement in monoclonal gammopathy is less frequent, limited papers exist on OCT angiography-based retinal circulation assessment. Since retinal blood flow mirrors systemic circulation, detecting even minor circulatory changes could enable early diagnosis, closer patient monitoring, treatment efficacy assessment, and complication prevention. With raised blood viscosity and reduced circulation possible in paraproteinemia, we aimed to evaluate retinal blood flow using OCT angiography in monoclonal gammopathy [5].

Monoclonal gammopathy is linked to hemorheological anomalies, like increased blood viscosity causing reduced blood flow. OCT angiography detects subtle capillary circulation issues, hinting at impending hyperviscosity syndrome. Identifying decreased circulation could mitigate complications,

such as bleeding disorders, vision impairment, and neurological deficits. Early microcirculatory disorder detection might facilitate timely intervention [6].

Conclusion

The reduction in superficial retinal vessel density detected through OCT angiography among individuals with monoclonal gammopathy indicates the likelihood of sluggish blood flow, diminished capillary circulation, and resulting tissue hypoperfusion attributable to elevated blood viscosity. Evaluating retinal blood flow in monoclonal gammopathy through OCT angiography-while considering the impact of image quality on OCTA measurements-presents a sensitive approach for non-invasively identifying and monitoring early-stage microcirculatory irregularities triggered by hyperviscosity.

Acknowledgment

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Conflict of Interest

None.

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