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ABSTRACT:

Heat and Mass Transfer in Inflammation-Induced Glaucoma

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Glaucoma is considered a complex and multifactorial disease, and its exact cause remains unclear. Damage to the optic nerve is often linked to increased eye pressure and reduced blood flow to the retina. Factors such as age-related oxidative stress, chronic mechanical and vascular stress contribute to retinal neurodegeneration. This oxidative stress is associated with cell ageing, mitochondrial dysfunction, excitotoxicity, and neuroinflammation, all of which can worsen glaucoma. Research indicates that alterations in tissues involved in visual information transmission and the optic nerve head are key, as well as in the eye's anterior chamber, concerning the impaired drainage system and elevated pressure found in primary open-angle glaucoma. These last phenomena can be studied by introducing engineering thermodynamics. In this paper, following the experimental results in the literature, we focus on a thermal approach to glaucoma-related inflammation in order to propose a thermal explanation of the process linking the macroscopic behaviour of the eye to alterations in ion fluxes in the tissues caused by inflammation. The result obtained is a thermal model that links the temperature increase to the mechanical work required to maintain the normal water fluxes in the anterior ocular chamber, with the consequence of changing the Gibbs free energy of the eye tissues, which induces an increase in pressure. Our result represents a theoretical approach in improving the comprehension of this temperature-pressure effect as a basis for future possible new therapeutic approaches to glaucoma disease.