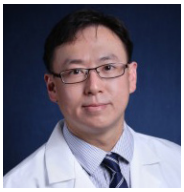

CORRELATIONS BETWEEN INTRAOCULAR PRESSURE REGULATION AND THE BIOMECHANICAL BEHAVIORS OF DISTAL AQUEOUS OUTFLOW VASCULATURE

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Purpose: Glaucoma is a leading cause of blindness globally. The intraocular pressure (IOP) outcomes of newer glaucoma surgeries are unpredictable, in part due to a gap in knowledge of tissue biomechanics at the level of distal aqueous outflow vasculature and the surrounding perilimbal sclera (PLS). In our previous studies, we established a multispectral photoacoustic microscopy (PAM) and finite element analysis (FEA) method to quantify the strains in individual tissue components. PAM-FEA confirmed the perilimbal sclera's (PLS) role in restricting deformations of aqueous veins.

Methods: Distal vasculature was identified by perfusing suspension of microspheres in whole globes. The steady state IOP of the eye at constant flow rates and the IOP elevation rate at constantly increasing flow rates were measured. PAM-FEA resolved the average cross-sectional area change of the aqueous veins and the deformation of surrounding sclera using 800 nm and 1200 nm illuminations, respectively. The volumetric flow through the vasculature was also quantified. The correlations between the volumetric flow, the IOP measurements, and the biomechanical behaviors of the tissue components were calculated. We also attempted to predict the IOP outcomes of our perfusion procedure using the biomechanical behaviors of the tissue components quantified by PAM-FEA.

Results: The results show that the cross-sectional area change of the aqueous veins and deformation of PLS parallel to the globe surface and the volumetric outflow rate are strongly correlated with the steady-state IOP. The deformation of the sclera perpendicular to the eye surface is not significantly correlated with the IOP measurements. The linear regression shows that the PAM-FEA measurements of the deformation of the tissue components and the volumetric outflow rate can be used to predict the IOP outcomes in our perfusion procedures at approximately 10% error.

Conclusion: These findings support our hypothesis that the PLS and aqueous veins with less deformation are correlated with elevated steady state IOP and less adaptive behavior of eyes to increased aqueous outflow volume.

Biography

Dr. Xu received his PhD and postdoctoral training in optical and ultrasound imaging in biomedicine. He received a predoctoral award from Congressionally Directed Medical Research Programs, a postdoctoral fellowship from American Heart Association, a Career Development Award from American Gastroenterology Association, a Senior Research Award from Crohn's and Colitis Foundation and an R37 MERIT award from National Cancer Institute.