

Alterations to Retinal Blood Flow Autoregulation in Human Subjects with Early Glaucoma as measured with Laser Speckle Imaging

Mary Ventimiglia, MS; Yash Porwal; Renad Alhabashi, BS; Grace Forbes, MS; Lily Im, MD; Sarah Ullah, MD; Sara Francomacaro, MD; Osamah Saeedi, MD

INTRODUCTION

- Glaucoma is a leading causes of blindness worldwide
- Early detection and intervention are critical to vision retention, but diagnosis typically occurs after vision loss onset
- The XyCAM RI is a minimally-invasive laser speckle contrast imaging device used to quantify metrics of retinal blood flow
- Dynamics of ocular blood flow (OBF) are altered in glaucoma
- OBF may have clinical utility as an early biomarker of glaucoma

OBJECTIVE

To evaluate the ability of ocular blood flow metrics to differentiate between eyes with glaucoma and eyes without glaucoma using the XyCAM RI

METHODS

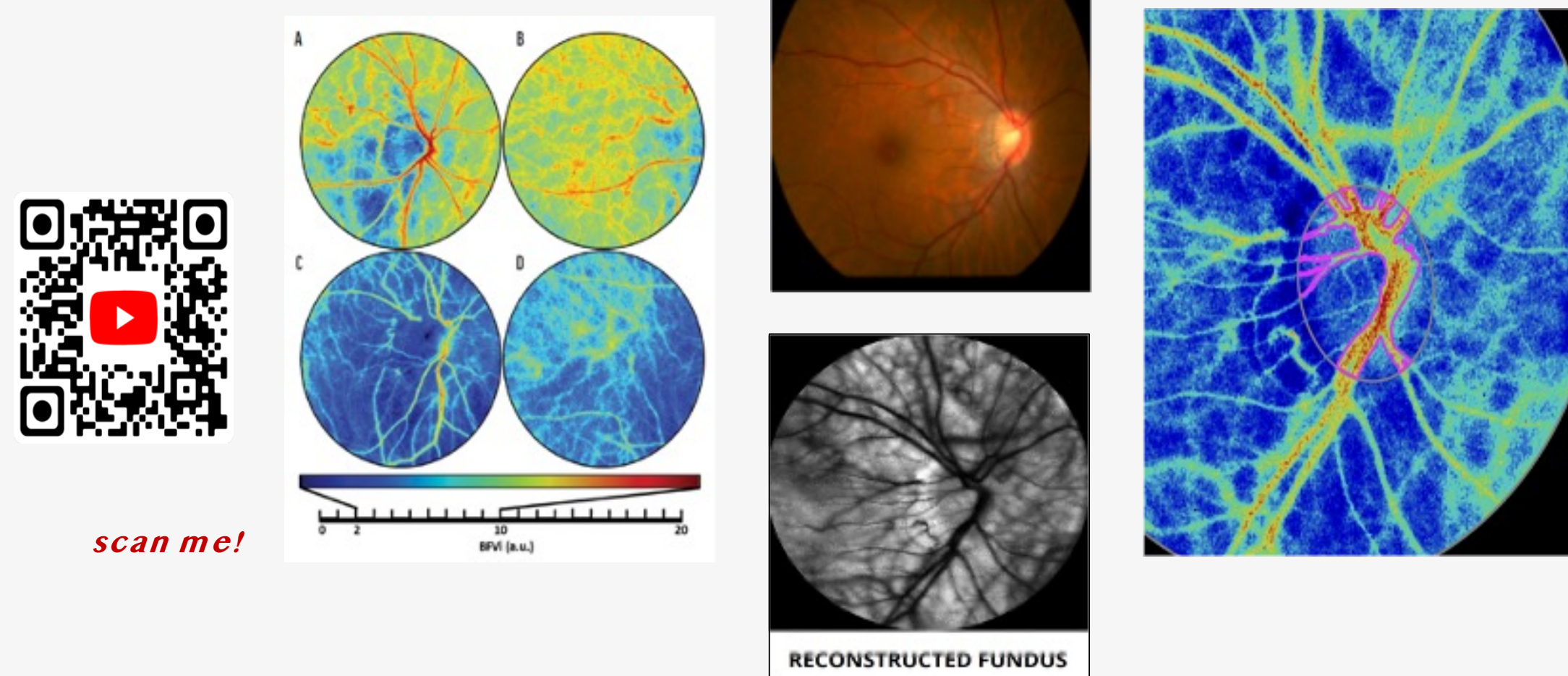


- Participants were recruited from the Redwood Clinic into control, pre-perimetric glaucoma, and mild glaucoma as per Hodapp-Parrish-Anderson criteria
- Sequential imaging was obtained with the XyCAM RI at baseline and induced-hyperoxia
- Blood flow velocity index (BFVi) metrics were recorded for each patient in each state (Figure 1) and were calculated in the optic disc, optic disc vessels and fundus

STATISTICAL ANALYSIS

- Paired t-tests: baseline and hyperoxia
- Unpaired t-tests: control, PPG, and mild POAG subjects

DATA ANALYSIS



- The XyCAM emits a low-power laser to capture a rapid sequence of photographs of the retina at a rate of 80 frames/second
- BFVi metrics are then calculated for each image session: peak, dip, rising mean, falling mean, Time-to-Rise (TtR), Time-to-Fall (TtF), Volumetric Rise Index (VRI) and Volumetric Fall Index (VFI)

PRELIMINARY RESULTS

Cohort Data

Overall

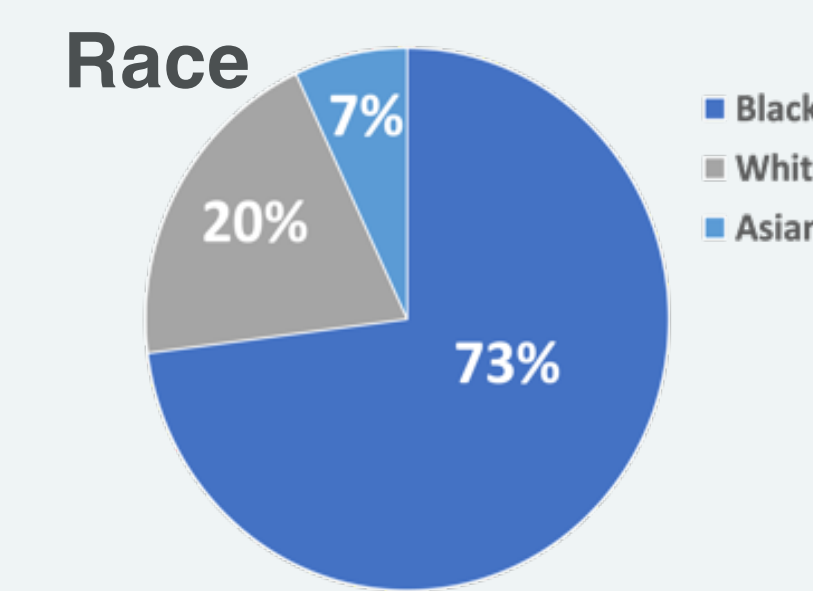
- 17 subjects
 - 11 mild primary open angle glaucoma
 - 7 pre-perimetric glaucoma
 - 2 controls

Gender

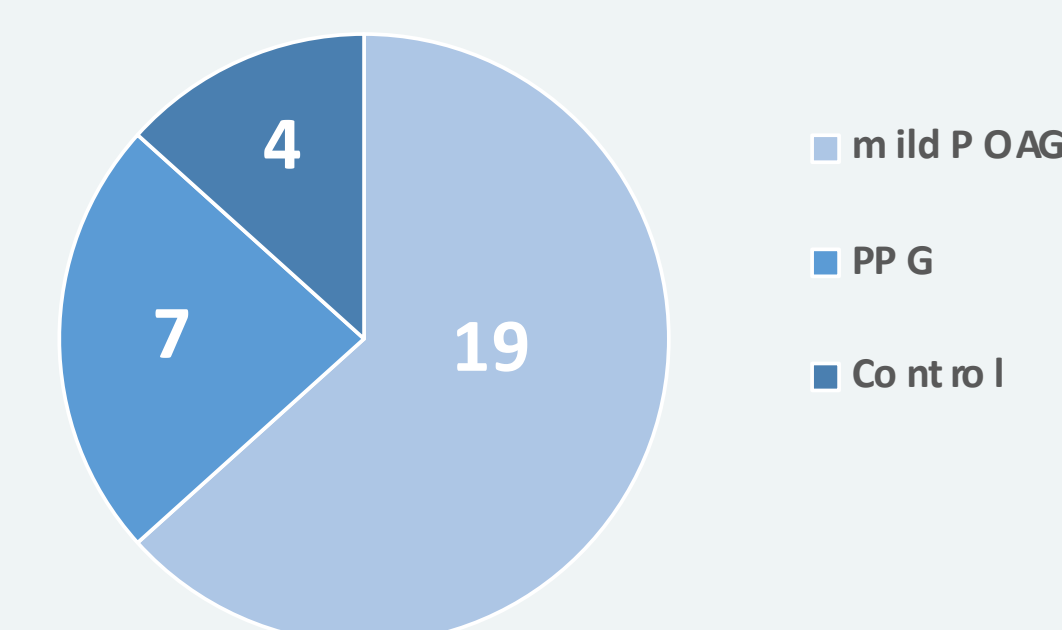
- 60% female and 40% male

Age

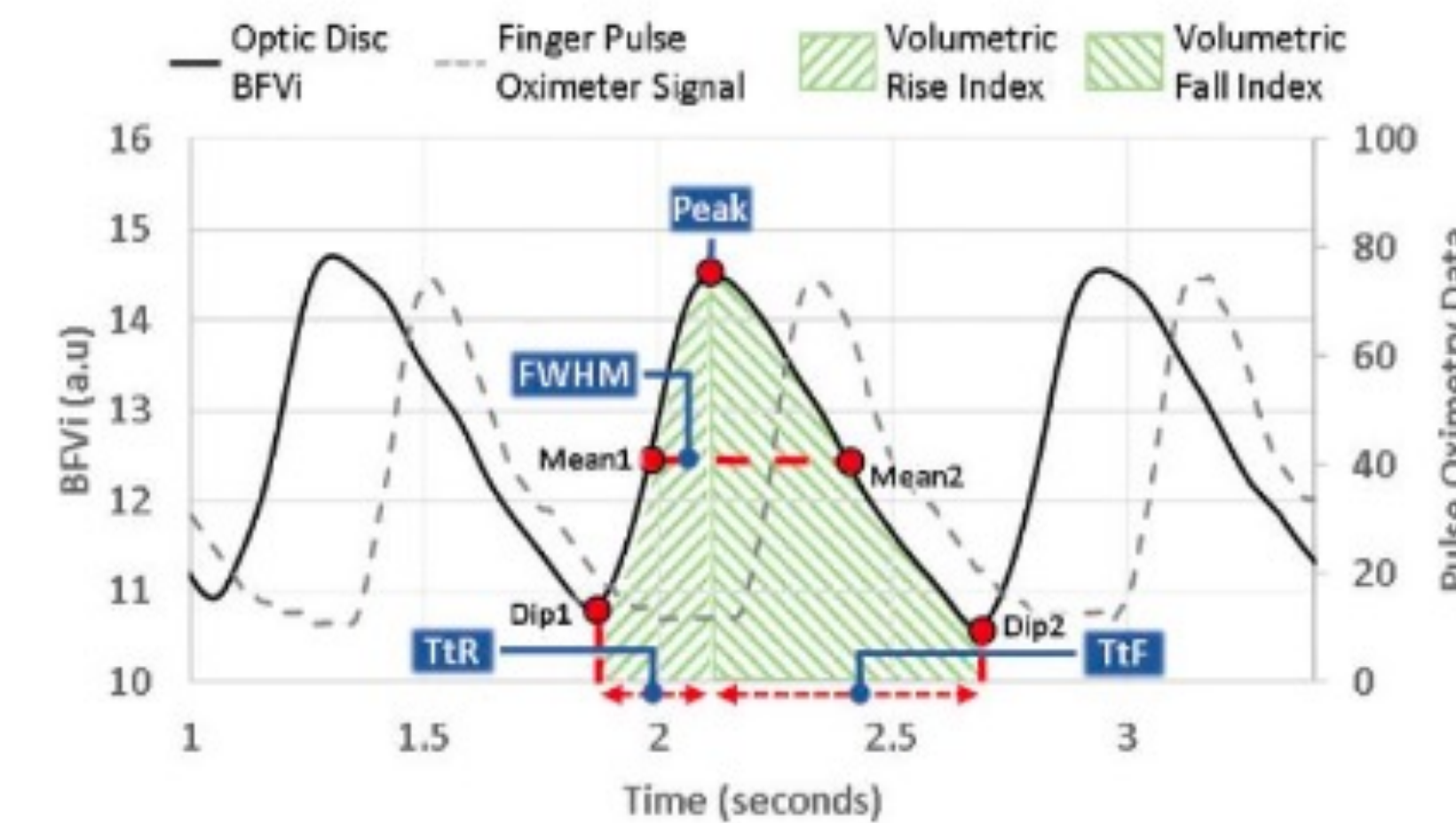
- Average 63 ± 11 years



Eyes included in analysis by Group

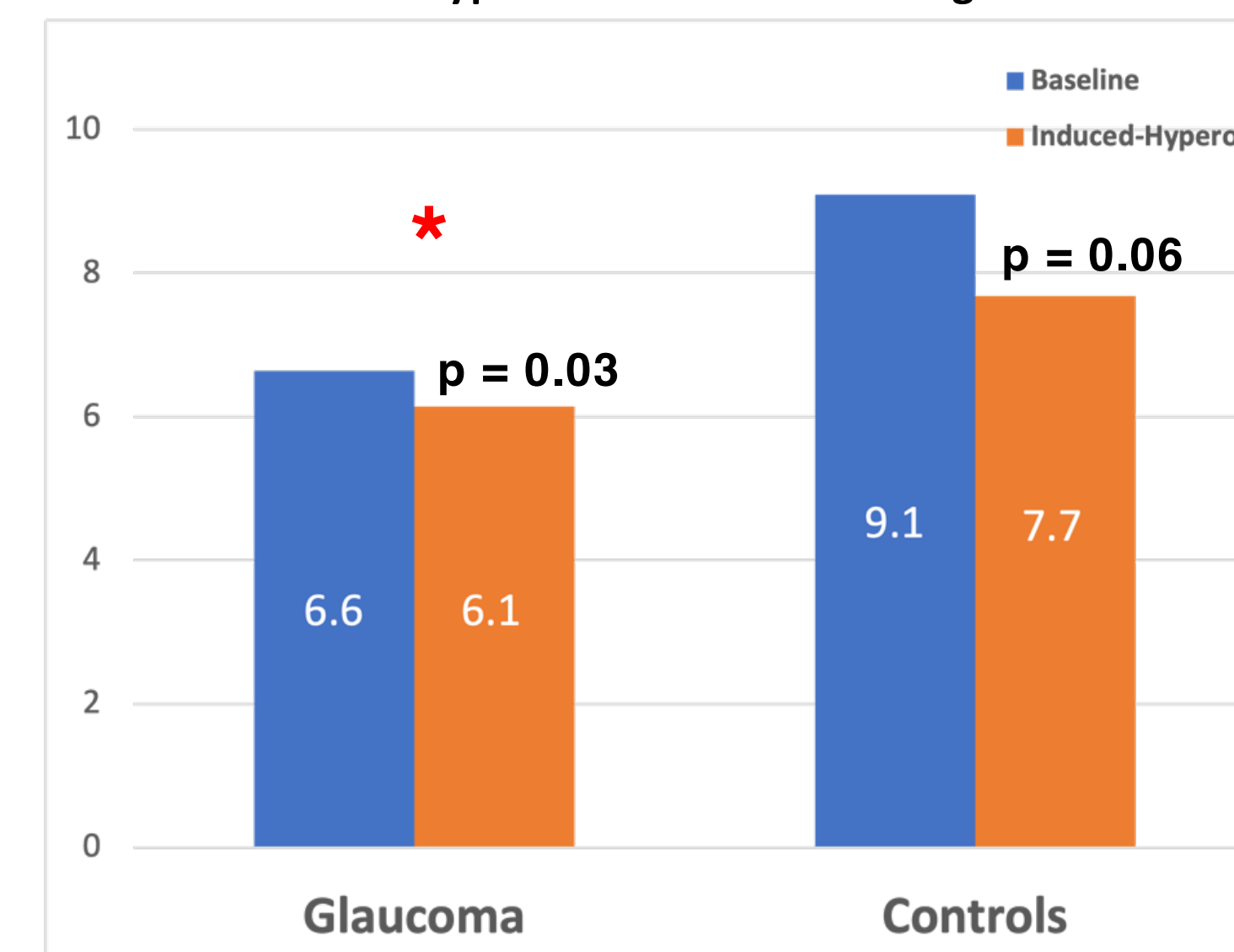


Glaucoma vs Control



Mean	= 0.5 × (Mean1 + Mean2)
Dip	= 0.5 × (Dip1 + Dip2)

Mean BFVi after hyperoxia-induced autoregulation



- **Mild Glaucoma:** mean BFVi was **significantly decreased** from 6.6 ± 1.1 at baseline to 6.1 ± 1.2 in hyperoxia; p = 0.03
- **Control:** a larger decrease in mean BFVi from baseline was shown from 9.1 ± 1.1 to 7.7 ± 0.8, but **did not reach statistical significance** in this small sample; p = 0.06
- Mean BFVi was **significantly greater in controls than in glaucoma subjects** at baseline, p = 0.0003 and hyperoxia, p = 0.08

DISCUSSION

- This pilot confirms distinct differences in baseline retinal blood flow demonstrated in our lab's prior work, while also suggesting alterations in blood flow autoregulation in glaucoma patients
- These data highlight **mean BFVi** as an indicator of pathogenic changes to dynamic blood flow in early glaucoma
- Chronic vasoconstriction secondary to loss of autoregulation may be the mechanism behind the lower baseline retinal perfusion in glaucoma compared to controls

CONCLUSION

- Progressive decline in perfusion of the optic disc correlates with autoregulation loss in vessels supplying the optic nerve head
- We hypothesize that a larger sample will show significantly greater perfusion changes in controls than in glaucoma and PPG
- This study is actively recruiting for all groups to increase its stratification power

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2. DeBuc DC, Rege A, Smiddy WE. Use of XyCAM RI for Noninvasive Visualization and Analysis of Retinal Blood Flow Dynamics During Clinical Investigations. *Expert Rev Med Devices*. 2021;18(3):225-237.
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