Hypertension Induced Change of Retina and Optic Tract in SHR

Qian Wang[1,2], Yunxia Li[1,3], Eric R Muir[1], Qiang Shen[1], Shiliang Huang[1], and Timothy Q Duong[1]

[1]*Research Imaging Institute, The University of Texas Health Science Center at San Antonio, San Antonio, TX, United States,* [2]*Xiang Ya School of Medicine, Central South University, Changsha, China,* [3]*Department of Neurology, Tongji Hospital, Tongji University, Shanghai, China*

Target Audience: Ophthalmologists, neuroscientists and hypertension researchers

PURPOSE

The goal of this study was to investigate the effects of hypertension on the optic tract integrity and retinal nerve fiber layer (RNFL) thickness in spontaneous hypertensive rats (SHR). Comparisons were made with age-matched normotensive Wistar Kyoto (WKY) rats.

METHODS

Male SHR (N=6) and WKY (N=6) at 40-week old were studied. Diffusion-tensor MRI on an 11.7T Bruker scanner was acquired with EPI with TR=3000ms, TE=29ms, FOV= 25.6x25.6mm, 96x96 matrix, eight 1.5-mm slices. Fractional anisotropy (FA) was analyzed for the optic tract.

RNFL thickness around optic disc was measured using optical coherence tomography (Micron III). The RNFL thickness was obtained in the area with the optic papilla as the center and 2 disc diameters. The histology of optic tract was studied using coronal brain sections (60μm) underwent Black-Gold® II stain for the white matter. The histology was analyzed using Image-Pro Premier Software (Version 6.0, Media Cybernetics). Error bars are SDs.

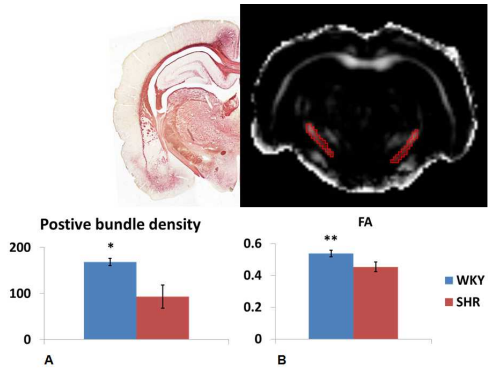

Figure 1:(A) Black-Gold® II stain of the coronal brain section that shows the optic tract. (B) FA of the same layer of brain that shows the optic tract.

RESULTS

At 40 weeks, blood pressure was statistically different between SHR and WKY (109 ± 10 versus 180 ± 13 mmHg, P<0.05). The optic tract FA (red ROI) of WKY was significantly different from that of SHR (0.538 ± 0.021 versus 0.454 ± 0.031, P < 0.01) (**Figure 1**). The positive bundle density of optic tract of the WKY was also significantly different from that of SHR (168 ± 8 versus 93 ± 25, P<0.05). The RNFL thickness of WKY was significantly different from SHR (207 ± 11 versus 165 ± 5 μm, P < 0.01) (**Figure 2**). There was also evidence of thinning of other retinal layers (such as the photoreceptor nuclear layers and the inner and outer segments) on OCT. On the fundus images, vessel diameters were consistently smaller in SHR compared to WKY, but quantitation is not possible on fundus images.

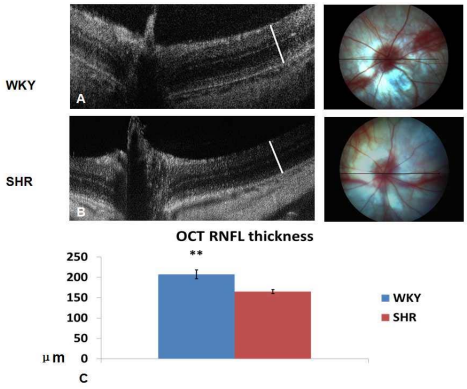

Figure 2: OCT image and fundus image of (A) WKY and (B) SHR. (C) Group RNFL thickness in μm.

DISCUSSION & CONCLUSIONS

Chronic hypertension is known to alter cerebral vascular morphology and cerebral blood flow (CBF), which could lead to chronic hypoperfusion, increasing susceptibility to brain disorders, such as ischemic stroke and cognitive decline, among others. The FA of the optic tract was lower in SHR compared to WKY, consistent with immunohistology. We interpret this finding as reduced white matter integrity from the negative effects of chronic hypertension. The effects of chronic hypertension on RNFL have not been previously studied in SHR. We found dramatic reduction in RNFL thickness of SHR in chronic hypertension, which is expected to manifest in visual dysfunction. Future studies will include functional visual tests, basal blood flow measurements of the retina, vascular reactivity in the retina, and earlier stages of hypertension.

In conclusion, we found evidence that chronic hypertension damage white-matter integrity in the optic tract (as indicated by FA disruption and immunohistology) and retina (as indicated by changes in RNFL thickness and vessel diameter) in an established animal model of hypertension.

REFERENCES: [1] Hayreh Curr Opin Ophthalmol 1999. [2] Wong TY Br Med Bull 2005. [3] Pantoni & Garcia Stroke 1995. [4] Masumura Neurosci Res. 2001.